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Electrical World

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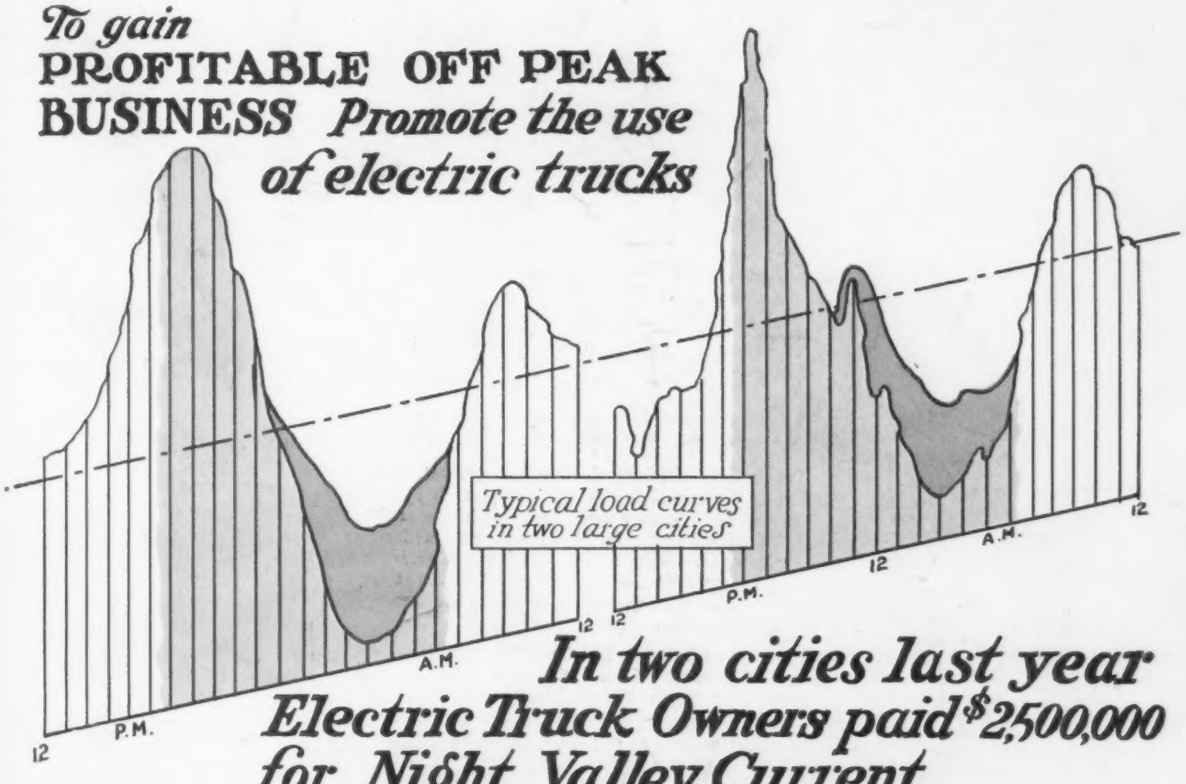

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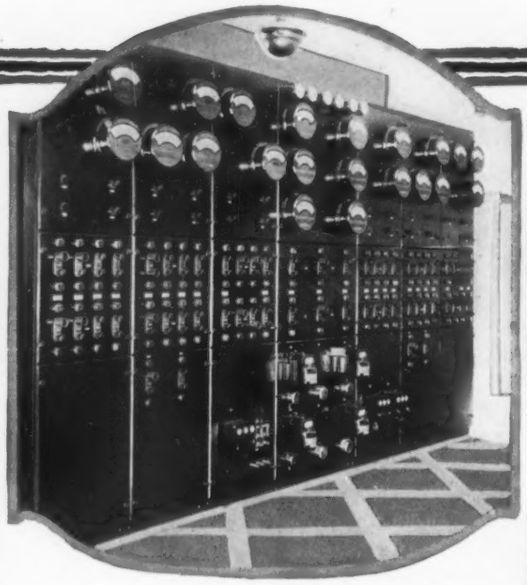
Distributors in Principal Cities

Load Capacities: ½ — ¾ — 1 — 2 — 3½ — 5 *tons*

WALKER ELECTRIC TRUCKS

LOWEST TRUCKING COST ON CITY ROUTES



Section of a Weston equipped central station switchboard

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Testing and checking the product you are making by the use of Weston Instruments is by far their most important use. And this is one of the principal reasons why Weston is standard the world over. The majority of manufacturers insist upon Weston instruments because they cannot otherwise absolutely certify to the quality of their product.

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Altogether, several million users throughout the world have purchased Weston Instruments and this is exclusive of the radio field.

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Weston Electrical Instrument Co.
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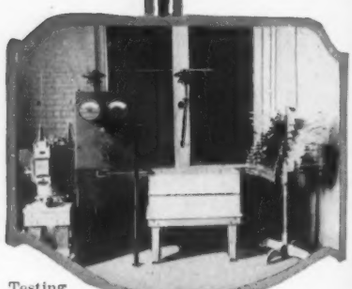
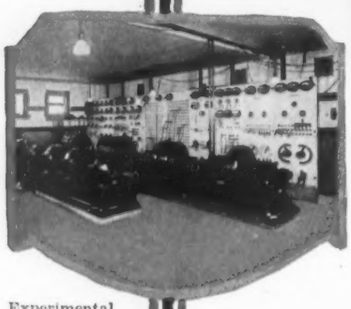
WESTON

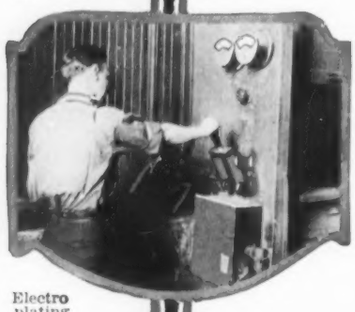
STANDARD - The World Over



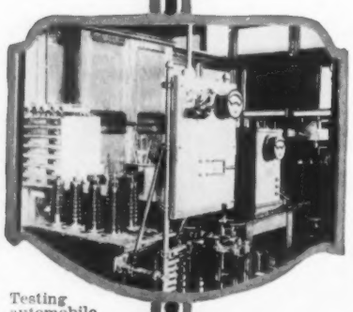
Testing rubber gloves



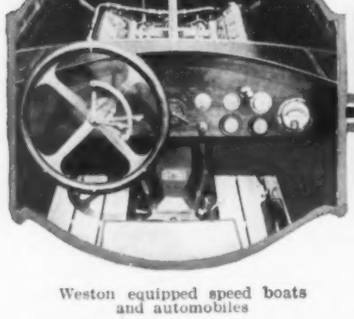
Experimental laboratory



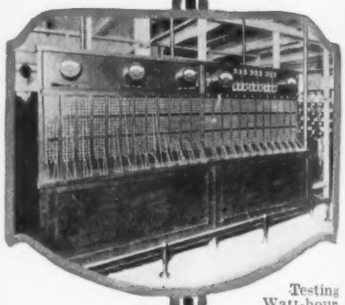
Electro plating



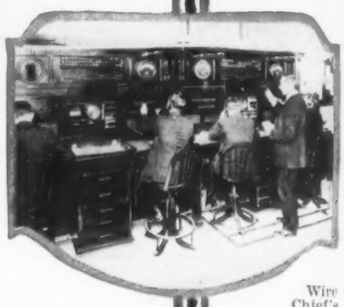
Testing automobile ignition



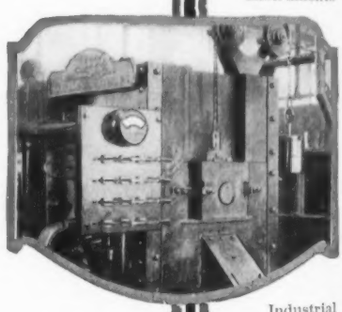
Weston equipped speed boats and automobiles



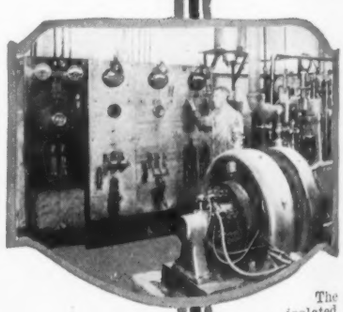
Testing Watt-hour meters



Wire Chief's Instruments

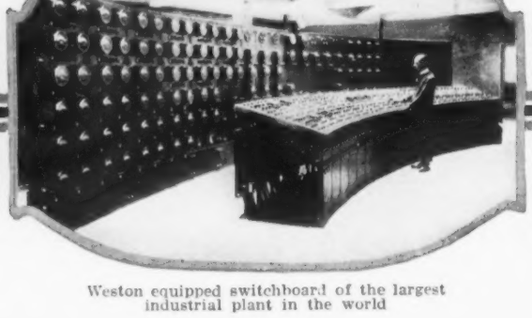


Industrial Heating



The isolated power plant

Weston for every radio need



Weston equipped switchboard of the largest industrial plant in the world

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

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What Will Become of the Colorado River Compact?

THE fate of the Colorado River compact still hangs in the balance as the result of the re-election in Arizona of Governor George W. P. Hunt over Dwight B. Heard, who stood for the treaty slightly modified and for speedy settlement of the Colorado River situation. Nearly two years ago six of the seven states concerned ratified the compact, but Arizona, under the leadership of Governor Hunt, has consistently refused to participate on the ground that the interests of that state were not properly protected. It is hard to believe, however, that six sister states conspired in drawing the Colorado River compact so as to cheat Arizona of her just rights. The action of Arizona's Legislature in repudiating the stand of the state's duly authorized representative at the Santa Fé conference, when the treaty was approved by him as well as by the representatives of the other states, was also hard to understand. Washington is reported to look upon the treaty as now virtually dead, and it is said that the Federal Power Commission will proceed to grant permits on the Colorado River despite its non-ratification; but inasmuch as the compact will again come before the Arizona Legislature at its session early next year, it is to be hoped that favorable action will yet be taken by that body.

Broader Association for Engineers

AS THE responsibilities of the engineer increase the need of broader association with men who are enlarging the boundaries of knowledge in many fields develops with great rapidity. President Stratton of the Massachusetts Institute of Technology emphasized this in an address at the recent centennial of the Rensselaer Polytechnic Institute, when he pointed out that the growing difficulty of engineering problems demands a higher standard of preparation for practice, the ability to co-operate with research workers and an understanding of how and when to utilize the services of experts. The planning of greater structures, development of more efficient prime movers, transmission of power over longer distances and the prevention of wastes that may mean the life of a business or even of an industry require an expansion of professional interest that not only puts a greater burden upon the engineering school but also puts the mature engineer on his mettle to cope successfully with the vast problems of modern civilization from his special angle of observation and experience.

The engineer of today has a far greater variety of materials at his disposal than ever before, but the progress of applied science not seldom demands other products in whose development the engineer must be ready and competent to participate. He cannot always be content with the scientific data at his disposal and must often take the initiative in its production, working in conjunction with the expert mathematician, physicist, chemist and geologist. In public affairs and in the relations between industry and labor the engineer's points of contact are also broadening, and the old conceptions of his "place in the sun" are fast giving way to new ideas of his sphere of usefulness, a sphere whose boundaries are as yet unmeasured by either the engineer or his clients.

The Mercury Rectifier Far Advanced in Europe

PROGRESS in the adoption of new electrical engineering methods proceeds at about the same rate in this country and in Europe. New types of equipment and new methods appearing on one side of the Atlantic are likely to make their appearance very promptly on the other side. This is due in large measure to various connecting links between the two continents, such as allied manufacturing companies, the exchange of patent licenses and the like. Such differences in methods as appear are usually to be attributed to special conditions obtaining in particular countries. For example, the pre-eminence of this country and its advanced position in the field of long-distance transmission are largely due to the exceptional distances and figures for power which are required by our expanding industrial demands.

An apparent exception to this parallel advance between the two continents is to be found in the great disparity between our use of the mercury rectifier and its increasing adoption on the other side. A number of years ago, with the first appearance of the rectifier, a considerable effort was made by manufacturers in this country to develop it to a stage in which it could be used for power purposes. The results of these efforts were apparently not such as to encourage market production. On the other hand, Europe never lost confidence in the possibility of the mercury rectifier, and her engineers are now convinced of its complete practicability. In the past few years particularly there have been an increasing number of installations with increasing values of power and voltage. One manufacturing company alone points to almost 150,000 kw. of its mercury rectifiers in service.

The experience of ten years and more has served to eliminate the small troublesome features that impair reliability. Some rectifiers have been operating more than four years continuously without having their cases opened, for example, and the European also claims that their economy in both first cost and in operation is now established. When production grows to a real volume, it is said, the over-all costs of a mercury-

rectifier substation will be nearly one-third less than those of an equivalent rotary substation, and efficiencies are claimed from 10 per cent to 20 per cent above rotaries for the same service.

The mercury rectifier has the special advantage of being able to handle rapidly varying loads—the almost complete absence of inertia in the rectifier arc adapting it admirably to such demands. This has shown it to be particularly desirable for use in electric traction. But a short circuit is still a troublesome factor, experience showing that the rectifier is the first of all equipment to go out in cases of short circuit. Another argument against it is that it does not permit the restoration of power to a system through regenerative braking. However, it requires a minimum of attendance, is entirely quiet, and in industry, in light and power supply and in railway work it is giving good account of itself.

Rectifier units are now in satisfactory commercial operation at from 250 to 500 volts (at 1,500 amp.) to 1,500 volts (at 600 amp.); that is, approximately 1,000 kw. is a standard commercial rating. Factory tests indicate satisfactory operation at voltages as high as 4,000, but the current then reduces to about 300 amp. Adaptation of the rectifier to 3,000-volt direct-current railway work is thus indicated.

It must be realized that the success of the mercury rectifier in Europe is under European operating conditions and demands. Many Americans do, however, agree with the Europeans that the rectifier has a good chance ultimately to replace the rotary, at least in railway work, and there may soon be opportunity to see how the rectifier will stand up under American operating conditions. Henry Ford has recently installed one in Detroit, the New York Edison Company is now installing one, and two substations of the Chicago Elevated Railways are to be equipped with them soon.

The Need of Electricity on the Farm

IN AN address last week before the Association of Land Grant Colleges, President Coolidge drew attention to the fact that the people of this country now consume more food products than the farms produce, and that before long we shall be reduced to the necessity of importing wheat and meat, both of which are now exported. According to the International Institute of Agriculture at Rome, the world's wheat crop is more than half a billion bushels short, and inasmuch as the United States is the only country indicating an appreciable increase in output in wheat in 1924 over 1923, Canada's wheat crop having suffered severely, good times are predicted for the American farmer.

The electrical industry should interest itself in this situation, because, with the children of farmers continually leaving the farm and with the scarcity of farm labor which exists, the United States would be unable to show this tremendous output of food products were not more and more machinery used on the American farm. Electricity is the greatest labor saver known, and aside from its application to stationary farm machinery, its use by the farmer's wife means more to the country than most people imagine. Unless the farmer's wife can cook and care for the farm help adequately, the farmer is severely handicapped in the number of acres that can be tilled. The household appliances already available would solve this problem of the farm, while motor-driven pumps, churns, food choppers and other farm apparatus would permit the farm help to devote more time to the crops. Without electricity on the farm, however, none of these advantages is obtainable. The electrical industry could, therefore, render a great service to the farm and to the country as a whole by hastening the day when a large number of farms will be electrified. The general prosperity of the farmer, of course, is a great aid to farm electrification, and every effort should be made to extend distribution lines to farms while the farmer is in the mood and has the money to pay for work.

The 1924 Autumn Meeting of the National Academy of Sciences

IT IS the custom of the National Academy of Sciences to hold its annual spring meeting at Washington, D. C., and its annual autumn meeting elsewhere. This year on November 10 to 12 it held its autumn meeting in Cambridge and Boston. Some of the sessions were held at Harvard University and others jointly with the American Academy of Arts and Sciences at the building in Boston of the last-named body. Only once before have these two academies held a joint meeting in Boston. The American Academy of Boston dates from 1780, before the end of the Revolutionary War. The National Academy of Washington dates from 1856.

Nearly eighty papers were presented at the three-day meeting. As there were no parallel sessions and all the papers had to be taken in series, the time allotted to each paper was restricted to preannounced periods, varying from ten to fifteen minutes. This called for strenuous efforts from the presiding officers and necessarily limited discussion. Nearly all scientific bodies find themselves nowadays between the horns of a dilemma owing to an embarrassment of riches in intellectual entertainment. They must either divide their attendance between parallel sessions—in which case they may allow adequate presentation and discussion of the papers, but the members complain of sectionalism and frequently desire to attend several sessions simultaneously—or they must take all their papers in single series, with a probable necessity of restricting presentation and discussion to inadequate limits. The pressure of growth drives them more and more to the parallel-session method.

The wide range of subjects covered by the program of papers was noteworthy. The main scientific divisions might be listed as astronomy, botany, chemistry, geology, history of science, mathematics, natural history, physics, philosophy and physiology; but these in turn would have to be subdivided or extended in order properly to include all of the papers. He would be a most learned man who could understand all of their titles. It is evident that scientists, in order to lead in any one branch of science, must specialize to such a degree that they are of necessity relatively ignorant concerning many other branches.

There were four papers on engineering subjects, all of which will probably soon appear in engineering journals. Papers read before either of these academies do not thereby enter into publication. Most of them, however, are, as a matter of statistical history, published within a year after such presentation.

An interesting paper from the electrical viewpoint

was one in the physiological group entitled "Conduction Without Decrement in Narcotized Nerve," by A. Forbes and H. Davis. Certain electrical tests of the behavior of a living nerve recently removed from the body of an animal were described. The results obtained, which have been confirmed by a Japanese physiologist, Kato, indicate that although the transmission of a nerve impulse along a nerve is accompanied by the simultaneous transmission of an electric impulse, yet no electric current flows along the nerve during the process, such as flows in an ordinary metallically conducting electric circuit. The electric disturbance transmitted along the nerve is supported by the energy stored up locally, so that a transient polarized condition is transmitted. The intensity of this condition is locally reduced in passing through a narcotized length of the nerve, but it is at once restored to substantially full value as soon as the narcotized length has been passed over. This is not at all the behavior of an ordinary electric circuit, in which, if the current strength is reduced by the interposition of a poorly conducting length, it is also and equally reduced along the remainder of the circuit.

Designs of 220,000-Volt Substations Differ

HIGH-VOLTAGE outdoor substations introduce many problems for engineers to solve, and it is interesting to note that more than one solution works out successfully. On the 220,000-volt lines in the West, designed and built by two different groups of engineers, a great dissimilarity in layout and equipment exists, but each installation has proved successful and the relative merits of design and equipment are still debatable.

One line uses arcing rings on insulators, while the other uses copper shields. One system uses a horizontally placed, chain-operated disconnecting switch and the other uses a link-motion, lever-type switch. One system by-passes all breakers with disconnecting switches, but the other omits this equipment. The most interesting and radical difference, however, resides in the methods used for supporting the high-tension buses. One system uses a high fabricated-steel framework with buses hung in tension according to the common practice, but the other system uses a bus structure supported on insulated pedestals placed on low concrete piers. Both of the installations have proved very successful, and the engineers of each system are well satisfied with their respective installations.

On a cost basis there would seem to be little choice, for while, on the one hand, a large steel structure is required, on the other hand, many insulator pedestals are necessary and much new development work is encountered. From an operating standpoint, it is easy to clean the pedestal-type insulators on the supported bus structure, but these insulators are near the ground and require cleaning more frequently. Danger from arcs on the tension structure can be balanced by hazards that may arise through mechanical stresses or expansion and contraction occurring on the supported structure. The relative appearance, simplicity and reliability are other elements on which taste and opinion affect decisions.

The encouraging feature of these installations is their service reliability to date, and it may be that the supported bus structure could be used to advantage on substations of lower voltage yet to be built in other parts of the country. The ultimate decision must wait on records of service life, including the modifications introduced by differences in operating methods and in location.

Color-Shadow Lighting— A New Source of Revenue

HARDLY a city exists which does not have a prominent monument or monumental building. With a few scattered exceptions, all are obliterated at nightfall. During the day their beauty may be marred by the surroundings. At night they may be set free from their environment and made to stand nobly out as an inspiration to their beholders. If the building is a commercial one, the publicity gained by courageous floodlighting is beyond calculation—as witness the Woolworth and Wrigley towers of New York and Chicago respectively. Color-shadow lighting produces even more impressive effects.

Why do not those in the electrical business promote this modification of floodlighting more aggressively, when it can be so easily shown that the artistic appearance of notable structures can thus be greatly enhanced and, in the case of commercial buildings, that excellent publicity will accrue because of the impossibility of extensive competition in this form of lighting?

Color-shadow lighting should first of all appeal to the illuminating engineer as a means of assisting architects in producing more beautiful effects by night. It should appeal to manufacturers of lighting equipment because of the greater use of equipment than with ordinary clear-flux floodlighting. It should appeal to all manufacturers of equipment used in the electrical industry because it creates an additional demand for apparatus and materials to serve the lighting installation. Color-shadow lighting should appeal to public utilities because it offers an additional load.

The projected area of buildings suitable for such exterior illumination ordinarily runs from 20,000 sq.ft. to 100,000 sq.ft., requiring a connected lighting load of 100 kw. to 1,000 kw. The burning hours run considerably beyond the peak and would average more than 1,800 per year. In other words, there is a potential energy sale of 180,000 kw.-hr. upward per building per year, or a revenue of at least several thousand dollars annually.

As is true of all other fields of lighting today, it cannot be hoped to build up this business by routine, commonplace or rule-of-thumb layouts based on some forgotten handbook. Color-shadow lighting especially must have inspiration and zeal behind it. It must convince and sell itself. The latest thought along this line is embodied in this issue in an article on colored floodlighting or color-shadow lighting by Edwin D. Tillson, testing engineer Commonwealth Edison Company, his paper having particular reference to a recent installation of magnitude in Chicago.

Every one who can see the commercial possibilities in this form of lighting, which has heretofore been used only for spectacular effects such as those at the San Francisco Exposition, and desires to profit by it will not only read but act upon the information given. Co-operation of architects will be sought, the pride of civic bodies will be stimulated, and the various branches of the electrical industries will work as a team to achieve what will benefit all.

Color Lighting Makes Building Exteriors Attractive

UNDER the stimulus of the color lighting at the San Francisco Exposition many buildings are now made ornamental and attractive. The McJunkin Building in Chicago is shown in the accompanying views and was the first to make a permanent installation. The art of color lighting has developed rapidly and equipments are now available for application to all types of building structures. The color is used in a supplementary way and no attempt is made to saturate an entire building.

Above—Color-shadow lighting of the McJunkin Building. Actually there is the effect of a beautiful Greek colonnade with vista of pure white columns standing out against pools of color that start with midnight blue and merge gradually through violets, purples and magentas into pure red at the cornice.

In center—Building model constructed for making experiments with colored floodlighting.

Below—McJunkin Building, with only the piers illuminated. A colonnade effect is possible with very shallow piers.

Color Lighting for Building Exteriors

Unusual Opportunities to Make Monumental Buildings Attractive—Principles that Must Be Applied to Avoid Objectionable Effects—McJunkin Building, Chicago, First Structure to Have Permanent Installation

By EDWIN D. TILLSON
Testing Engineer Commonwealth Edison Company

IT IS rather strange that since the San Francisco Exposition no extensive use of color has been made in floodlighting building exteriors. This in spite of the fact that the colored effects at the exposition constituted the most striking feature of the fair and obtained the widest kind of publicity and favorable comment. It is hard to account for this failure to utilize a readily available means of producing a beautiful spectacle on monumental buildings, unless it is a lack of knowledge of the fundamentals that underly such applications, or the fear of using color in such a way as to produce a bizarre effect.

BENEFITS OF COLOR LIGHTING

Several advantages are gained by the use of color.

First—Color is attractive in itself.

Second—Walls of a color tone corresponding roughly to the color flux projected thereon will respond more strongly than under flux containing all the colors of the spectrum. This well-known fact probably accounts in a large measure for the fact that a wall will stand out more prominently, or at least attract more attention, when lighted in color to a low intensity than will the same wall lighted to the same intensity by clear flux. If single-tone illumination is carried far enough and if the color is sufficiently pure, the wall can be made to appear almost incandescent.

Third—The use of color permits variegating the appearance of the building at will to a much greater extent than is possible with clear flux. Doubtless many architects would welcome the opportunity to use more color in the decoration of buildings if they could avoid overdoing it. With colored light the amount and kind of color is under perfect control, and the amount of color decoration can be modified or eliminated at any time if so desired.

Fourth—Color offsets shabbiness. For example, consider an old building that is fairly weathered. If it is strongly lighted with clear flux, whatever defects there are in the façade will be accentuated, whereas with colored flux the dirt and shabbiness would be minimized. Recently a case came up where the owners of a building desired to floodlight a court surfaced with a terra cotta of a salmon tone. The building had been erected about twenty-five years and was not in the best shape. Of course, it could be rejuvenated to some extent by acid cleaning, but it was considered that clear flux would be too harsh on this material. An orange-amber flux sprayed against the surface from half-urns placed at strategic points was recommended and proved most effective.

Another factor that brings color to the front for floodlighting at this time is the tendency to limit building heights unless the structure is stepped back from the building line progressively at certain elevations. Ordinances to that effect are in force in New York, Chicago and probably in other cities, and even where this is not the case, the vogue in architecture as applied to a high building is toward this type of building. It is the opinion of the author that this practice is going to bring about a different form of floodlighting, and particularly the use of color, because such architecture creates pockets and offsets that can be strongly splashed from points of vantage on the building itself. In this way more striking and interesting effects can be obtained than where the building is uniformly lighted from a battery of floodlamps across the street or at some distance from the building.

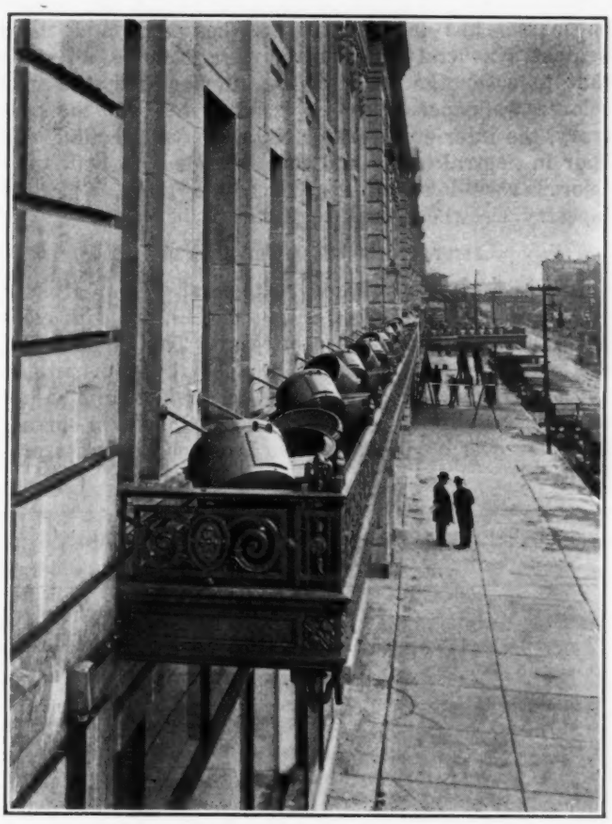


FIG. 1—BALCONY OF MCJUNKIN BUILDING, CHICAGO, DESIGNED TO CONCEAL COLOR DRUMS

The blue flux is pointed into lower "reveals" and the red into the upper. The piers are sprayed with clear flux.

ABANDONMENT OF OLD FORM OF FLOODLIGHTING

Probably one of the most unsatisfactory aspects of floodlighting in the past, aside from timidity as to the use of wattage, has been the commonplaceness and flatness of the illumination. Heretofore the attempt has almost invariably been to light buildings with uniformity and practically without shadows, whereas shadows are purposely created by the architect to give character to a façade.

Already an abandonment of the older forms of floodlighting can be observed in such buildings as the new San Joaquin Light & Power Building, Fresno, Cal.; the Edgewater Beach Hotel, Chicago; the Tribune Tower, Chicago; the McJunkin Building, Chicago; 40 West Fortieth Street, New York, and the Bush Terminal Building, New York.

As asserted before, this form of floodlighting lends itself particularly to the use of color. Simply to throw a carpet of red light over a building from a distant battery would accomplish nothing. In fact, it would be contrary to all the rules of color decoration, one of the cardinal points of which is that color should not be used en masse, but in brilliant splashes here and there against a neutral background. For example, all know that to cover the walls of an interior with violently colored wallpaper is not in good taste. On the contrary, the interior decorator tints the walls, ceiling and floor in neutral colors and then introduces a brilliantly colored vase here, a bright cushion there, a bit of tapestry elsewhere, and so forth.

LIMITATIONS WITH COLOR SCREENS

Likewise with building exteriors. The attempt should be not to saturate an entire building with color but to use it in a supplementary way. This is, no doubt, fortunate for all concerned, because the transmission of the various color screens that are available is so low that the installation and energy cost involved in spreading color over any considerable area soon becomes prohibitive.

OBSERVED TRANSMISSION FACTORS OF VARIOUS COLORED MEDIA*

	Medium	Average and Range of Transmission — Per Cent			
Vacuum Lamps	Natural-colored glass bulbs...	(Transmission factors depend on hue, saturation and actual mixture of coloring materials used. They can be as high as those of colored glass accessories.)			
	Lamp dips and lacquers.....	(Transmission factors depend on hue, saturation and actual mixture of dyes used. They can be as high as those for colored glasses, but the dyes are not permanent.)			
		Red	Green	Blue	Amber
	Sprayed lamps (standardized values).....	8 to 10	4 to 5	2 to 2.5	50 to 60
	Sign-lamp caps, 10-watt size...	11 to 17	9 to 12	2 to 3	30 to 45
Gas-Filled Lamps	Color caps for 150-watt lamps	20 17 to 22	7 6 to 8	4 3 to 4	26 21 to 33
	Color caps for 150-watt lamps (Second lot).....	22 19 to 26	10 6 to 16	11 9 to 13	40 38 to 46
	10-in. colored-glass roundels.	7 69 to 9	8 5 to 9	4 4 to 5	37 33 to 43
	Gelatine filters for show-window reflectors.....	5.2 4.8 to 5.7	17 17 to 18	1.3 0.9 to 2	48 45 to 50

*Luckiesh and Taylor, *Transactions Illuminating Engineering Society*, February, 1924, page 141.

In measuring the transmission of thick colored-glass accessories it is necessary to allow sufficient time for them to reach a sensibly constant temperature before measurement. In testing a 10-in. round lens it was found that the transmissions at the end of five minutes differed from the values immediately after lighting by the following amounts: Red, —15 per cent; green, —6.5 per cent; blue, +3.5 per cent; amber, —15 per cent. In other words, with the average floodlighting projector fitted with "heat-resisting" glass lens a person can figure on utilizing from 4 to 8 per cent of the light for the blues and greens and from 10 to 15 per cent for the reds.*

*Curtis Lighting, Inc., Chicago, states that the red available at this writing has a transmission of from 12 to 14 per cent.

The qualifying adjective "heat-resisting" is used, but in reality only the red and clear pyrex lenses withstand temperature, while the blue and green lenses split up within a few minutes after turning on. The amber may or may not do so. The only solution of this difficulty that has been applied with any success is used on the McJunkin Building, Chicago. In this case the color lens is sandwiched between two clear lenses and allowed to break as it will. The pieces cannot escape. Of course, this makes for still greater absorption (probably of the order of 15 per cent generated lamp flux) and also produces quite a heavy door, which must be handled with care when cleaning or relamping.

As a result of the light absorption just noted, it is found that in using color, the "throw" or "carry" of pure color is limited, and variously so. For example, with any ordinary value of watts per square foot of building surface the colors of short wave length (blues, greens, etc.,) cannot be expected to carry with any great effectiveness beyond 20 ft., while the reds and ambers, etc., may be thrown to distances of 30 ft. or 40 ft.

LACK OF UNIFORMITY DESIRABLE

A corollary to these statements is that color cannot exist within any appreciable field of clear flux. It will, however, exist within the shadows formed by a beam of clear flux, which leads to the contemplation of "color-shadow" lighting. "Color-shadow" effects have been used a great deal in the various fields of illumination, if not in architectural lighting. The most beautiful and practical color effects on building exteriors will be found within this category, and it is believed that is where the legitimate use of color will in the future be manifested.

If the line of reasoning developed so far is correct, the following conclusions are logical, namely, that the greatest possibilities lie in high-lighting the relief portions of a building with clear flux, strictly confining the effect to these portions by the use of spill shields, that the projectors should be concealed on the structure itself, and that within the deep shadows formed by the "reveals" and structural niches should be created whatever color motifs are found to be beautiful and appropriate, bearing in mind the limitations of color.

No uniformity, such as has been attempted in the past, will be possible with this scheme, but the very lack of uniformity may be used to create a spectacular and beautiful effect. For example, architects very frequently desire to increase the apparent height of buildings by accentuating the vertical lines of the structure, employing columns or piers for the purpose. But on account of the high cost of real estate in cities and the necessity of providing a maximum amount of daylight these piers must be made quite shallow. The whole design is a compromise. Under the older forms of floodlighting these piers lost what little value they might have had (under directional sunlight) in creating shadows. However, with the scheme outlined, it has been proved that a series of piers with only a 4-in. "reveal" can be made to stand out at night as a Greek colonnade with a most striking appearance.

MODEL DEMONSTRATES PROBLEMS

All such points appear simple enough as related, but they did not so appear a year ago when the Commonwealth Edison Company was commissioned to color-light the McJunkin Building, Broadway and Wilson

Avenue, Chicago. It was only by constructing a building model of fair size (patterned after a Western building, not the McJunkin Building) and by furnishing it with various lighting equipments that the facts were plainly revealed. This model, illustrated on page 1090, is approximately 7 ft. high by 9 ft. long and is fitted with removable columns and alternative facings.

COLOR-SHADOW LIGHTING MODEL

Concealed on or about the structure are forty "Eveready" flashlight reflectors, (catalog No. 2612), forty "Eveready" flashlight reflectors (concentrating type, catalog No. 2672), forty 3.8-volt G-4½ bulbs (No. 1193), and forty 3.8-volt G-3½ bulbs (concentrating No. 1163). The color projectors are fitted with gelatine screens held in miniature spinnings. The

FIG. 2—SPILL SHIELDS APPLIED TO CLEAR-FLUX PROJECTORS TO AVOID DESTROYING COLOR BETWEEN PIERS

four standards, 22 ft. (to scale) in front of the building, are copied after the standards designed by W. D'Arcy Ryan for the San Francisco Exposition. They conceal three projectors each, plus a local lamp for illuminating the amber transparency.

The model was used to illustrate the use of color-shadow lighting and also the application of the above standards, which is useful only where space between the standards and building is not traversed by the public, otherwise the glare is prohibitive. It demonstrated some of the subterfuges (as they might be called by some) that are necessary in the use of color at short range. For example, it is awkward and relatively expensive to produce a continuous lighting effect above a cornice such as that shown. On the other hand, a spotted illumination would be objectionable unless there is some good reason for making it spotted. This reason may be manufactured out of hand by adding to the architecture a bold frieze. Behind the prominent portions of the frieze and spaced regularly some feet apart may be placed high-wattage units. The color, fanning out from behind these ornaments, is graceful and apparently by design.

Foliage was added to illustrate the strong response of colored objects to flux of the roughly corresponding wave length. It is well known that fernery, etc., is greatly enhanced and freshened by such treatment, and possibly this constitutes one of the few conservative choices of color open to illuminating engineers and architects in the treatment of purely monumental buildings.

W. D. McJunkin, after whom the building under consideration is named, is strongly convinced of the great advertising and utilitarian value of "higher illumination." He started out with the idea, among others, that the building should be the best lighted in the country. But, contrary to usual custom, he did not wait until it was completed before divulging his intention to the lighting man. On the contrary, he brought the Commonwealth Edison Company's lighting personnel into touch with the architect at the very inception of the project and asked them to work together. As a result, many architectural features were changed at the outset, and more later on, in order to conceal the flood-lighting projectors from view and to present a façade of such design, color tone and texture as would respond in the greatest degree to the colored floods.

FIRST PERMANENT COLOR-LIGHTED BUILDING

The structure is the first one in the country to be permanently flooded in color which bathes the building in beautiful changing tints from dusk until 11.30 o'clock nightly. It can be observed on approaching the building that there is an ornamental iron balcony that extends the entire length of the structure. This balcony is at the second-floor level and conceals approximately 250 floodlight projectors, chiefly of 500 watts capacity each. The projectors are so trained that there is the effect of a beautiful Greek colonnade with a vista of pure white columns standing out against pools of color that start with a midnight blue and merge gradually through violets, purples and magentas into a pure red at the cornice. A belt of golden light above the cornice and one just above the store fronts complete a display which changes from end to end of the building at intervals of about six seconds.

As regards wattage, the exterior load is believed to establish a record in floodlighting. There are 2,250 watts every seven lineal feet of frontage in addition to cornice, marquise, sign and special flag illumination.

The interior is also brilliantly illuminated, with unusual features throughout. For example, in the corridors (also used as entrances and exits to the rapid transit lines) the luminaires incorporate miniature railway cars, with windows brightly lighted. They serve to call attention to the traction facilities so intimately connected with the building. By examining Fig. 1 it will be noted that one pair of 500-watt drums (the blue) are trained into the pockets at the second floor (immediately over the drums), while another pair (the red) throw light up against the third floor and the cornice above. Fig. 2 shows the care used to prevent the clear flux from spreading over into the color and so destroying it.

On account of the extremely short range of the blue, also of the clear projectors, it was found necessary to use sand-blasted lenses in order to prevent striations on the wall. In general this plan was adhered to rather than to employ corrugated reflectors, which would spill the light through an angle of almost 180 deg.

TIMIDITY REGARDING WATTAGE

There appears to be a natural hesitancy to install sufficient wattage per square foot of building surface demanded for a good color-lighting job. It is the opinion of the writer that if the principles herein outlined are adhered to, good results can be obtained with about

10 watts per square foot, or possibly a little less if amber constitutes the principal use of color. These figures refer only to the area treated in color, which probably will be much less than the entire area of the façade. In this connection it is believed that the greatest single failure in the field of exterior lighting has always been timidity and lack of conviction in the use of wattage. Throughout the country are many examples of buildings illuminated to the extent of from 0.5 watt to 2 watts per square foot. This might be sufficient for an obelisk planted in the middle of a desert on a moonless night, but it is a dismal failure on a building in a business district or a well-lighted street. Such limited use of wattage is worse than wasted, because it is a poor recommendation for other floodlighting installations. On the other hand, buildings illuminated with 5 watts to 15 watts per square foot have gained the greatest publicity through this method of lighting, and the results are positive. The owners of such buildings have been highly satisfied. For example William Wrigley, Jr., has duplicated the lighting of his original building in Chicago in the new building to the north on Michigan Boulevard. A number of buildings that were lighted to the extent of from 1 watt to 2 watts per square foot are not lighted at all at the present time because the management considered the effect so trivial as not to warrant the expense which would be entailed.

In mentioning the foregoing figures reference is made, of course, to buildings that have a reflection factor of around 60 to 65 per cent and that are susceptible to maintenance. This figure corresponds to cream-toned terra cotta or similarly reflecting surfaces. The lighting schemes outlined in this article all involve grazing angles fairly, so that the use of highly glazed building surfaces is open to objection. In other words, the reflection of glazed material will be largely of a specular nature, and the light will be directed upward and away from the spectators, whereas a material which has been depolished to a certain extent will still be cleanable and will return an appreciable amount of the light into the zones that are useful.

Electrical Progress in Belgium

ONE of the most important electrical undertakings in Belgium is the Société Intercommunale Belge d'Electricité of Brussels, which has now no fewer than eight generating stations with a total capacity of 107,400 kw., an increase of 82,150 kw. during twelve months. In view of the ever-increasing demand, it has been decided to put further extensions in hand in order to bring up the capacity to 150,000 kw. Thus two new 13,600 kva. turbo-alternators are to be put down at the Roux station, while at the Paturages station, although this is now linked up with the plant at Monceau-sur-Sambre by a 50,000-volt transmission line, a further generating set of 8,200 kva. is to be installed. At the Monceau plant a third 15,500-kva. turbo-alternator has lately been completed and a fourth set of 16,700 kva. is contemplated. At the Malines station a fifth turbo-alternator of 15,500 kva. and a 50,000-volt transformer plant are being added, the latter being intended to link up the station with that at Alost. At the Sweveghem station a fifth generating set of 11,500 kva. is being installed, and a third of similar capacity is in course of erection at the Alost station.

What Radio Means to the Central Station

Lighting Revenue Already Increased $10,000,000—The Added Income from Radio May Reach $75,000,000 Yearly

BY DAVID SARNOFF
Vice-President and General Manager
Radio Corporation of America

CENTRAL-STATION companies generally have enjoyed a material increase in revenue from residential customers directly and indirectly through their operation of radio receiving apparatus. In a number of instances it has been possible for a company to "spot" the individual customers whose bills have jumped up from fifty cents to a dollar per month after the purchase of a radio set. These, of course, were isolated cases, and no complete survey of the aggregate amount of this increase has been possible. But it has been conservatively estimated that the additional revenue derived by all electric light and power companies from the fact that more people stay at home to listen to the radio, thereby using more light, amounts at least to $10,000,000 annually. This factor, substantial as it is, is but one source of added income, and the importance of radio in terms of energy consumption and possibilities of further development deserves the careful consideration of central-station companies.

The vacuum tubes employed in the radio receiver require a source of uniform direct current to light the filament and to energize the loud-speaker circuit. Up to this time this energy has been supplied by storage batteries and dry batteries. Although the operation of radio apparatus has been greatly simplified of late and the necessity for making adjustments and renewing parts has been materially reduced, those of us in close relation with the business have long recognized that to make radio operation more ideal, the storage battery and the battery charger, and even dry batteries, should not be the sole means of power, when a source of lighting current is available.

Present indications, therefore, point to two methods of operating radio receivers in the near future. These might be classed as follows:

Type 1—The home receiver that will draw its vacuum-tube energy through a current-supply device operated from the lighting circuit of the central station.

Type 2—The rural home receiver or the portable receiver that obtains operating power from storage or dry batteries.

In other words, while a permanent demand already has been created for the dry battery or storage battery to operate the receiver, the rising requirements of the art will find place, I believe, for a new and additional type of current supply, such as is now under discussion.

THREE MILLION RADIO RECEIVERS

Upward of three million radio receivers are in daily use in this country, rendering entertainment and other services to about ten million listeners. It has been determined that of the three million radio receiving sets now in use, approximately two million are of the storage-battery type, nine hundred thousand operate completely from dry batteries, and the remaining one hundred thousand are of the crystal-detector type requiring no batteries.

Of the two million storage-battery type of sets, by far the greater proportion employ three vacuum tubes, but a great number also utilize from five to ten tubes. Considering the extensive use to which the average radio receiver is put each day and the great amount of experimental work being carried on by radio enthusiasts, the storage battery of the average radio receiver requires two charges per month. On this basis central stations now receive a monthly revenue from battery charging of 80 cents per radio installation, which gives an estimated total revenue per year of approximately twenty million dollars.

ENERGY DIRECT FROM LIGHTING CIRCUIT

Recent developments reported by radio apparatus manufacturers indicate that the future type of receiving set will include a simple device which can be interposed between the lighting circuit and the vacuum tubes of the radio receiver, thus energizing these tubes directly from the power mains. This device promises to be of a character calling for infrequent attention, adaptable to existing and future types of receiving sets without necessitating changes in the design of the vacuum tube or in the set itself. Already a few such current-supply devices have appeared on the market, and others are in varying degrees of perfection.

To the general public such a device would mean a simplicity of operation now exemplified in the lighting of an electric lamp by the turning of a switch. To the central-station industry this would result in transferring to its distribution lines a load which it has only partially enjoyed up to this time, for this device will supply the grid and plate voltages for the vacuum tube as well as the filament voltage.

The commercial and technical advantages of a current-supply device would be very great. First, it would provide a steady and uniform voltage to the vacuum tube. It would require practically no attention on the part of the user except as it may be necessary to replace parts after extended periods of use. It would make the installation and use of the radio receiver as simple and convenient as the operation of a lamp or vacuum cleaner. No changes in present-day receivers are called for in the use of the current-supply device.

As stated previously, central stations receive increased revenue from the fact that more people stay at home to enjoy radio, which means more use of lights and greater energy consumption. Radio enthusiasts who stay up until the small hours of the early morning to "get distance" still further increase this use. While figures are not available to show the amount of energy consumed by these factors, it is roughly estimated that the increased revenue amounts to approximately $10,000,000 per year. As the number of radio sets increases, this figure will correspondingly increase.

CENTRAL STATIONS SHOULD SELL RADIO

That the use of radio receivers will multiply greatly in the next five years is unquestionable. On Jan. 1, 1924, there were approximately 11,750,000 wired homes in the United States. Another 1,500,000 will probably be added by the end of the year. At the end of five years at least 15,000,000 homes will be wired and it is safe to predict that at least one-half of these will be equipped with radio. Assuming the widespread use of a current-supply device, it is estimated that the average use of the radio set in each home would draw 6.5 kw.-hr. per month. Based on a rate of 10 cents per kilowatt-hour for energy this would yield approximately 65 cents per month, which would result in additional revenue to the central-station industry of more than fifty million dollars a year.

Radio, therefore, from a load-building and revenue standpoint, offers a large opportunity for the central station. With its existing equipment for merchandising appliances and its servicing facilities, the light and power company is a logical outlet for the sale of radio apparatus to its customers.

This business could be made very profitable, not only in the sale of the current-supply device, but also in the sale of radio receivers, accessory material and replacement items, such as the vacuum tube. Already the central stations have intimate contact with the home, through the use of many electrical appliances which have become so necessary a part of daily home life. The ability of the central-station appliance store to supply radio sets and devices on a "part-time-payment" basis and to add the monthly installments to the electric light bill affords a splendid opportunity for increased sales to customers who might otherwise be unable to purchase and own a radio set. There is also an important public relations aspect in building good will. Once radio is a well-advertised and permanent sales unit of the central station, it will become a valuable agent in creating store traffic—in short, bringing sales prospects to the store—a problem of all merchants.

SERVICING THE EQUIPMENT

From the standpoint of the public—and, after all, this is the controlling interest in the situation—the service that the central-station company could render to the radio user would seem apparent.

While radio sets have been simplified and made trouble-proof to the degree that they do not require an inordinate amount of attention, it is nevertheless a fact that all machinery and devices do require periodical inspection and adjustment. Here is a further opportunity for the electric light and power companies to make their service more indispensable and valuable to the public.

The central-station industry's interest in radio may be summarized briefly as follows:

1. Serving as it does millions of American homes with a constant power supply, the central station offers a connecting link for a new and simplified form of vacuum-tube current source. This would make the modern radio set as easy of operation as any other item of household equipment.

2. The central station today stands as having developed a type of home servicing unique in American industrial history, and in radio service is an important sales factor.

3. With the constantly growing demand for radio equipment, logical channels of distribution should be further developed to give the largest measure of service to the American public. And since the central station already is equipped for this work it can properly undertake the distribution of radio equipment.

4. It is estimated that the addition of radio to central-station activities would, within a reasonable period of time, result in an increased revenue of about $75,000,000 per year for increased consumption alone, not including profits derived from radio sales and service. This would be an increase of approximately 16 per cent to the income at present derived from residence customers.

Power-Factor Correction in Practice—I

Use of Static Condensers for Individual Motor Correction—Facts and Opinions Gleaned on One Property—What Customers Think of Results Obtained—Greater Production and Better Operation Chief Gains

By L. W. W. MORROW
Associate Editor ELECTRICAL WORLD

"POWER-FACTOR correction has been talked about for many years, yet little progress has been made on a national scale. In fact, there seems to be a diminution of interest in the subject just now. You have studied this question for years. Do you think that power-factor correction is worth while, and can you explain why it has not been attempted more generally by central station companies?"

These questions were asked of Charles J. Russell, vice-president of the Philadelphia Electric Company, a nationally recognized authority, who has long studied the possibilities of power-factor correction and has instituted it very successfully on the system of the Philadelphia Electric Company.

"Power-factor correction is the one major economic opportunity remaining in the light and power industry," replied Mr. Russell. "It affords great possibilities for economic gains in industry as a whole and splendid opportunities for improving service and operating conditions. And, in answer to your other question, I believe it has made little progress because it has not received serious consideration from many executives in the light and power industry. It has been a vague conception in their minds and has encountered the inertia associated with the activities of a flourishing industry."

"But," interposed the interviewer, "it is said that technical, financial, public relations and commercial considerations make it difficult to institute power-factor correction as a part of the practical operations of a power system. The selection of the proper type

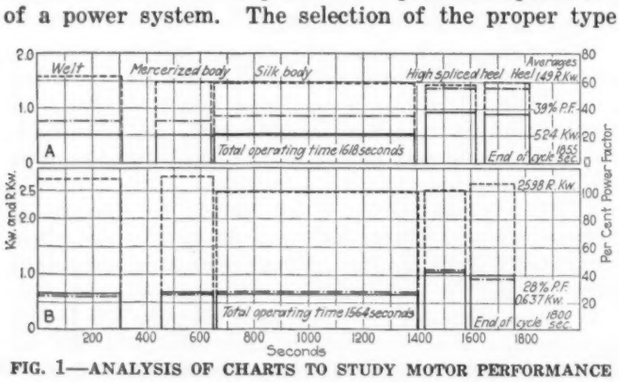


FIG. 1—ANALYSIS OF CHARTS TO STUDY MOTOR PERFORMANCE

(a) Cycle of operation of Reading full-fashioned knitting machine from chart in Fig. 3 (a); equipped with 1-hp. motor.
(b) Cycle of operation of Reading full-fashioned knitting machine from chart in Fig. 3 (b); equipped with 1½-hp. motor.

and quantity of corrective equipment, the education of the customers, the cost and the inadequacy of metering equipment and methods, the difficulty of handling the investment charges, the task of making rates satisfactory to customers and regulatory bodies—all these elements are said to be great obstacles. In other words, it is said that the economic gains to the power customers and to the utilities are impossible to obtain in practice."

"That's all nonsense," replied Mr. Russell energetically. "We have done the job successfully on this system, and it has paid big returns to the customers and to ourselves. The difficulties you mention melt

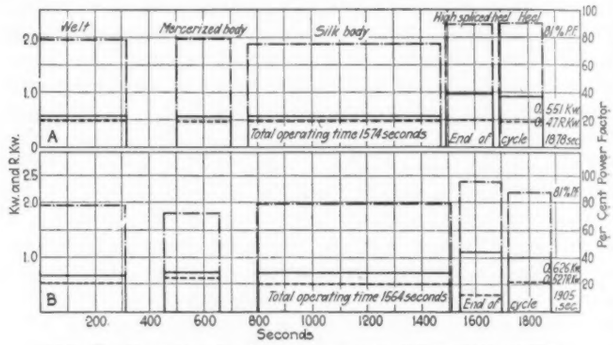


FIG. 2—EFFECT OF CONDENSERS ON KNITTING CYCLES

(a) Analysis of charts when 1 kva. in condenser was used on machine whose characteristics are shown in Fig. 3(b) and Fig. 2(a); equipped with 1-hp. motor.
(b) Analysis of charts when 2 kva. in condensers was used on machine whose characteristics are shown in Fig. 3(a) and Fig. 2(b).

away, provided an intelligent study is made of system conditions and power-factor correction is applied properly. It is fundamental that the customer as well as the utility shall benefit financially, and that is the key to the whole situation. We have no trouble of any character on this system and have ample data to show that power-factor correction is both possible and profitable."

The interviewer asked for some of these data in order to publish them for the benefit of the industry and requested permission to visit some of the customers and get their views on the subject.

HOW THE PLAN WORKS

Mr. Russell cordially replied: "Certainly, we are glad to give you anything you want and hope your data will be helpful." He then introduced J. F. Gaskill of his department and told him of the request for data. Mr. Gaskill was very cordial and quickly answered the usual question: "What do you think of the possibilities of power-factor correction?"

"To tell you the truth," he said, "I am pretty tired talking about power-factor correction, for it has been settled on this system and in my mind so long that it has become an old story. Power-factor correction is working splendidly on this system. It gives us no trouble, takes very little time and involves very little expense. It pays us and it pays the customers. We have about 24,000 corrective kva. on customers' premises, of which about 4,000 kva. is in static condensers and the remainder in synchronous machinery.

At first we gave a lot of time and study to the question and carefully tested plants and scrutinized all power bills. But that period has passed and everything has been reduced to routine."

"But how do you care for billing and how do you get corrective equipment installed?" was asked.

"Our wholesale power rate," he replied, "is based on tests made under normal operating conditions in a plant. This gives data for fixing kw. and kva. demand limits and determines the power-factor charges to be applied under the contract. We make about two hundred such tests a year, and the average cost of each test is less than $6. Once the contract is signed, routine billing is made from the readings of a polyphase watt-hour meter and a kw. demand meter installed on the customer's premises. Naturally, if the test kva. demand is high compared with the kw. demand, we tell the customer that power-factor correction will reduce his bill. This usually creates interest, and we recommend that he get in touch with representatives of manufacturers of corrective equipment. They do the engineering work required and call on us sometimes to make any special tests that may be desirable, but tests of this character are seldom required now that a sufficient number of installations from which data can be procured are available. To sum it all up, a great deal of work and study is required initially in installing power-factor correction, but that stage soon passes and it becomes a normal and routine part of system activities."

Many details were discussed, and then it was suggested that he give the names of some customers who had put in corrective equipment.

Mr. Gaskill gave the names of several customers, and the next task was to traverse the distances between them and interview executives and operators about power-factor correction. This took the better part of two days and covered installations in fruit shops, hoisiery mills, knitting mills, leather factories and iron works. At each place the interviewer was received courteously and obtained a detailed and enthusiastic account of the results of power-factor correction. He was shown the books and the installations and was given permission to use any or all the information and in addition permission to use quoted statements of executives in regard to their satisfaction with power-factor correction. Space will not permit an elaborate analysis of all the plants visited, but a few typical examples may prove interesting.

These examples are all characterized by the use of static condensers at each motor application and cover only this field of power-factor correction. Later articles will cover aspects of correction involving other corrective devices. The unit correction examples are chosen first because this type of correction is considered very difficult to institute as a commercial business.

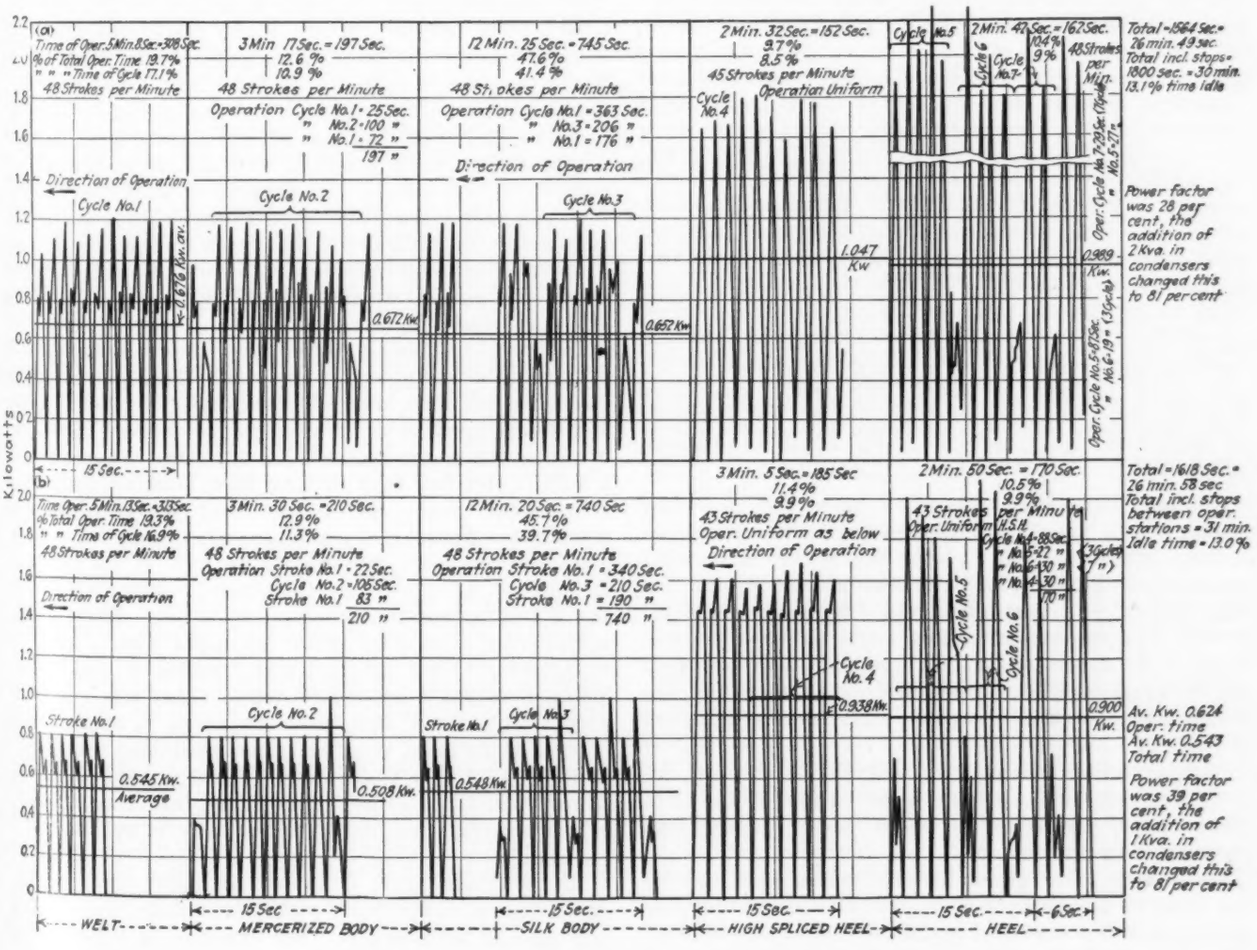

Kilowatts
(a)
Time of Oper. 5 Min. 8 Sec. = 308 Sec.
% of Total Oper. Time 19.7%
" " " Time of Cycle 17.1%
48 Strokes per Minute
Direction of Operation
Cycle No. 1
0.676 Kw. av.
15 Sec.
3 Min 17.5 Sec. = 197 Sec.
12.6 %
10.9 %
48 Strokes per Minute
Operation Cycle No. 1 = 25 Sec.
" No. 2 = 100 "
" No. 1 = 72 "
197 "
Cycle No. 2
0.672 Kw.
12 Min. 25 Sec. = 745 Sec.
47.6%
41.4 %
48 Strokes per Minute
Operation Cycle No. 1 = 363 Sec.
" No. 3 = 206 "
" No. 1 = 176 "
Direction of Operation
Cycle No. 3
0.652 Kw.
2 Min. 32 Sec. = 152 Sec.
9.7%
8.5%
45 Strokes per Minute
Operation Uniform
Cycle No. 4
1.047 Kw.
Cycle No. 5
Cycle No. 6
Cycle No. 7
2 Min. 42 Sec. = 162 Sec.
10.4%
9%
48 Strokes per Min.
Oper. Cycle No. 7 = 29 Sec. (Idle)
" No. 5 = 27 "
Oper. Cycle No. 5 = 8.5 Sec.
" No. 6 = 19 = (3 Cycles)
0.989 Kw.
Total = 1564 Sec. = 26 min. 49 sec.
Total incl. stops = 1800 Sec. = 30 min.
13.1% time Idle
Power factor was 28 per cent, the addition of 2 Kva. in condensers changed this to 81 per cent
(b)
Time Oper. 5 Min. 13 Sec. = 313 Sec.
% Total Oper. Time 19.3%
" " Time of Cycle 16.9%
48 Strokes per Minute
Direction of Operation
Stroke No. 1
0.545 Kw. Average
15 Sec.
3 Min. 30 Sec. = 210 Sec.
12.9%
11.3%
48 Strokes per Minute
Operation Stroke No. 1 = 72 Sec.
Cycle No. 2 = 106 Sec.
Stroke No. 1 83 "
210 "
Cycle No. 2
0.508 Kw.
12 Min. 20 Sec. = 740 Sec.
45.7%
39.7%
48 Strokes per Minute
Operation Stroke No. 1 = 340 Sec.
Cycle No. 3 = 210 Sec.
Stroke No. 1 190 "
740 "
Stroke No. 1
Cycle No. 3
0.548 Kw.
3 Min. 5 Sec. = 185 Sec.
11.4%
9.9%
43 Strokes per Minute
Oper. Uniform as below
Direction of Operation
Cycle No. 4
0.938 Kw.
2 Min. 50 Sec. = 170 Sec.
10.5%
9.9%
43 Strokes per Minute
Oper. Uniform
Cycle No. 5
Cycle No. 6
0.900 Kw.
Total = 1618 Sec. = 26 min. 58 sec.
Total incl. stops between oper. stations = 31 min.
Idle time = 13.0%
Av. Kw. 0.624 Oper. time
Av. Kw. 0.543 Total time
Power factor was 39 per cent, the addition of 1 Kva. in condensers changed this to 81 per cent
WELT
15 Sec.
MERCERIZED BODY
15 Sec.
SILK BODY
15 Sec.
HIGH SPLICED HEEL
15 Sec.
6 Sec.
HEEL

FIG. 3—EFFECT OF MOTOR RATING ON KNITTING CYCLE

(a) Complete cycle of an eighteen-unit Reading full-fashioned knitting machine equipped with a 1½-hp., 1,200-r.p.m., two-phase, 60-cycle, type MQ140 motor; chart speed, 3 in. per minute; two standard integrating wattmeters and reactive component meters used. (b) Complete cycle of the same machine equipped with a G. E. 1-hp., 1,200-r.p.m., 220-volt, two-phase type MQ122 motor.

An interesting story relates to the experiences of Largman & Gray, manufacturers of silk hosiery. Their original factory was wired with six motors of from 1 hp. to 1½ hp. on each No. 8 circuit and contained the following equipment for two-phase, 220-volt operation:

Eighteen 1½-hp. wound-rotor 1,200-r.p.m. motors.
Twenty 1-hp. wound-rotor 1,200-r.p.m. motors.
One 2-hp. squirrel-cage motor.
One 3-hp. squirrel-cage motor.

The circuits were heavily loaded and operated very hot, and yet additional machines were to be installed. The electrical contractor and the owners were faced with the necessity of rewiring or correcting the power factor at the motors. Power-factor correction was first tried because the plant was operating at an average power factor of only 33.5 per cent. One kva. of condenser capacity was placed with each motor on one circuit. This raised the power factor of that circuit from 24 to 40 per cent and served to reduce the heating very greatly. This one test "sold" power-factor correction to Mr. Gray, one of the owners, and he became much interested in the subject. The corrective kva. necessary to bring the plant power factor to 80 per cent was 54½, and it was installed by placing 1½ kva. and 2 kva. on the 1½-hp. motors and 1 kva. on the 1, 2 and 3-hp. motors.

The data on power cost and hose production were assembled for four months before correction and for three months after correction—a period covering finishing operations. An analysis of results is given in Table I.

TABLE I—POWER-FACTOR CORRECTION IN HOSIERY PLANT

	P.F.	Kw. Demand Billed	Kw.-Hr. Light	Kw.-Hr. Power	Total Bill	Dozen Pairs Hose	Kw.-Hr. per Dozen Pairs Hose	Cents per Dozen Pairs Hose
Before Correction								
Average over four months	33.5	61.0	1,488	5,705	$368.50*	7,408	0.86	4.95*
After Correction								
Average over three months	80	33.2	426	4,203	250.00	7,879	0.588	3.17
Per cent reduction	....	45.2	....	26.4	32.20	.....	31.6	34.0

*The cost includes the cost of light, which is greater in the period before correction because of the season. With an allowance of even $50 for light the saving is still in the order of 20 per cent.

Another installation was then made for the same company in a factory containing ten 1½-hp. motors on hosiery machines, one 1½-hp. motor on a sewing machine, one 2-hp. motor on a sewing machine and one ½-hp. motor on a ventilating fan. No test was made to determine the corrective kva. required, but estimates based on the experience on the first plant were prepared and 20 kva. installed. Tests were then made by the Philadelphia Electric Company with results indicated in Table II.

The correction indicated in test No. 3 was left installed in this plant, and an examination of the data shows clearly the effect of power factor on the kva. losses in lines and motors.

Soon after after these installations a new factory was built by Largman & Gray. Competitive bids were received for the electrical installation, and the winning bid was made by the same contractor who had installed the corrective kva. in the older installations. He proposed to use unit corrective kva. and advocated the use of nine or ten 1-hp. to 1½-hp. motors on each No. 6 wire, 220-volt, two-phase circuit. In his plans there were seven circuits on each of three floors and a total installation of 192 motors. This installation was made and the factory is operating. The operators of the knitting machines, the foremen and the owners are enthusiastic boosters for power-factor correction, and the saving in cost of power is only a small part of the gain. The machines were asserted to operate faster and more smoothly so that more hose and a smaller number of rejections resulted per unit time.

RESULTS IN A LEATHER FACTORY

Another interesting example is the case of the Wittman-Moriarty Company, manufacturer of leather goods. As outlined by L. C. Wittman, the story is that in an old plant they had a 75-hp. steam engine, but when they built the new plant their engineers advocated electric drive and installed a total of 205 hp. in motors

TABLE II—EFFECT OF VARYING CORRECTIVE KVA.

Test No.	Kw.	Reactive Kva.	P. F.	Corrective Kva.
1	7.92	3.93	0.893	20
2	8.7	5.47	0.845	18½
3	9.02	6.43	0.82	18

which operated at a power factor of 52 per cent. The bills were so large that power-factor correction was determined upon. The plant was studied carefully and the motors were classified. Then one motor of each class was tested and the value of corrective kva. determined from the test data. These tests also afforded data to change the motor arrangements to advantage. For example, two 25-hp. motors had been used to operate five tanning drums. Since the average load was between 22 hp. and 26 hp., all the drums were placed on one 25-hp. motor equipped with 6 kva. in condenser capacity. The use of the capacity raised the power factor of this installation from 76 to 99 per cent. The reason for the high power factor on this motor is that it operates ten hours per day at the end of a long circuit which has several small intermittently loaded motors also connected.

In another instance three rows of reels had been used with a 10-hp. motor on each. These reels were connected by belts, and all were driven by one 10-hp. motor equipped with 2 kva. in condenser capacity, bringing the power factor to 92 per cent. Then, again, a 5-hp. motor had been driving three staking machines and another 5-hp. motor was used on two glazing machines. These loads and an air compressor were placed on one 5-hp. motor with 1½ kva. of condensers. In addition, a 3-hp. motor drove two brushing machines and a 5-hp. motor two finishing machines. These loads were driven by a 5-hp. motor equipped with 1 kva. in condensers. Two new glazing machines had been installed with a 5-hp. motor drive. This was replaced with a 3-hp. motor equipped with 2 kva. in condensers.

In this one plant remotorization permitted the elimination of 62 hp. in motor capacity and raised the power factor from 52 to 70 per cent. Then, installing 42 kva. in condensers, the power factor was raised to 87.1 per cent.

Mr. Wittman said: "Aside from any other gains, the saving in power costs were tremendous, and we are very pleased with results. For example, it saved us in power-factor charge about $1,200 per year."

Another interesting installation was that at the factory of the E. A. Wright Company, maker of bank-notes and stationery. In addition, two tenants in the

same building were on the same service. One of the tenants had a 5-hp. motor. The other made knit ties and full-fashioned hosiery.

Mr. Beauchamp of the Wright company said he went into power-factor correction when the Philadelphia Electric Company applied its power-factor rate to his load. He was very enthusiastic about the results obtained and said there was a saving in power-factor charges alone of about $85 a month. A study showed the Wright factory to be well motored and 16 kva. in condensers were installed to bring the power factor to 80 per cent. Then 1 kva. in condensers was placed on the 5-hp. motor of one of the tenants. But the knitting factory was found to operate at a very poor power factor and to be poorly motored. After a study the following machines were eliminated:

Five 1½-hp., 450-r.p.m. motors operating with about 13 per cent power factor on an average and only 24 per cent on the peak.
One 1-hp., 600-r.p.m. motor.
One 1-hp., 900-r.p.m. motor.
One 1-hp., 450-r.p.m. motor.

The eight motors were replaced with eight 1-hp. back-geared 1,800-r.p.m. motors, and the power factor, after changes were made, was 56 per cent. The original motors required 14½ kva. in condensers to bring the power factor to 80 per cent, but only 4 kva. was required after remotoring.

The installation had a 49.5 kw. demand originally, and this was decreased to about 40 kw. by the changes. Mr. Lauber, one of the proprietors of the knitting factory, said: "All the machines operate more satisfactorily now than before and there is no question as to the operating benefits derived. The rearrangements cost about $3,000, but this will be returned in direct savings in less than two years." The operators of the knitting machines said that the operations were better and smoother and rejections fewer.

Another interesting case was reported in the E. A. Wright shop. A 3-hp., 1,800-r.p.m. motor on the end of a long service and driving a printing press would frequently stall. Investigation showed a 15-volt line drop; so 1½ kva. in condensers was installed and the motor worked successfully while the amperes at peak load dropped from 14 to 10½. Only 2 kva. in condensers was necessary to bring the machine up to a satisfactory power factor. The total corrective kva. in this installation was 54½ in order to bring the plant power factor to 80 per cent.

Bad Motoring in Iron Foundry

The Belmont Iron Works consist of a fabricating plant which uses some electric power. A test of the installation made by the Philadelphia Electric Company showed the average kw. to be 54.7, the reactive 90 and the power factor 51.9 with 92 kw. as maximum demand. This would have required 63.45 corrective kva. in condensers to secure 90 per cent. But a complete plant test by engineers showed that remotoring was advisable in many cases. Two 10-hp. motors with bad characteristics were replaced with two 5-hp. motors. A 30-hp. motor-generator set would require 19 kva. to correct to 90 per cent, but the use of a good motor of the same rating and speed permitted the correction to be made with 8 kva.

Changes such as these enabled the plant power factor to be brought to 94 per cent, with a total of only 30 kva. in condensers as compared with the original requirement of 63.45 kva.

In several factories the trail of two energetic representatives of the National Electric Condenser Company, J. L. Merrill and W. J. Herrick, had been crossed, so time was taken to interview them and ask the question: "What do you think of the possibilities of power-factor correction and how do you sell corrective equipment?"

"There is no question in my mind that power-factor correction is workable and is profitable to the central station, the customers and the manufacturers of corrective equipment," replied Mr. Merrill. "Our experience shows that the first sales are difficult. It is necessary to make tests, to 'live' with each job and to apply sound economic and engineering analyses. Very frequently, also, it is necessary to remotor a customer or redesign his circuits before determining the corrective kva. needed. This usually means less kva. sold, but it means a good, conscientious engineering job that makes a customer a corrective-equipment salesman.

"After a few sales are made in factories of particular types the work becomes easier because test data are available from past installations and former customers help to convince new ones. We co-operate heartily with the central station, the consulting engineers and the electrical contractors and gradually have built up a standing and a sufficient number of installations to reduce the cost and time required on new sales to a minimum. The biggest talking point used by former customers is that the indirect savings resulting from more and better production are much greater than those obtained by reductions in power bills. We believe power-factor correction is a big move for the better in the electrical industry as well as a good commercial plan."

Conclusions

These visits and experiences afford opportunity for some conclusions about power-factor correction in general and about individual motor correction in particular:

1. The Philadelphia Electric Company has found it both profitable and feasible to institute power-factor correction on customers' premises as well as in other parts of the system.

2. A successful power-factor correction business must be made as a result of a study of each electric system because of the many differences encountered between properties. But each system adopted need not be hedged about or limited by reason of rate clauses, metering equipment, public relations or type of corrective equipment. All types of corrective devices should be used in their respective fields of application and the rate clause need only to offer a financial inducement to the customer and the central station. Billing methods and forms can be devised to meet the conditions to be met on a given system.

3. The central station should initiate power-factor correction in the first instance and should make it attractive to manufacturers and customers. But co-operative effort between the central station, manufacturer of corrective equipment and the customers is required to succeed in the work. A slow progress will be noted during the initiatory period of correction, but as the system comes into wider use it is adopted more readily and extensively. Consulting engineers, contractors and "sold" customers are glad to co-operate in advocating correction once experience has been obtained.

4. Once a system rate and billing method have been adopted power-factor correction is an economic and engineering job of a specific character for each in-

stallation of corrective equipment. Manufacturers of corrective equipment must have a sales and engineering staff competent to do process analytical work, make economic studies and if necessary revamp the motorization of a factory. Central stations must make tests and analyses and co-operate fully with customers and manufacturers of corrective equipment.

5. Poor power factor in factories is due to three things which are in order of importance:

(a) Use of motors of improper characteristics or of motors too large for their normal work.

(b) Inherent characteristics of certain types of motors and transformers.

installations good engineering thought must be given to anticipating any production changes that may be desired.

6. The use of unit correction at motors can be used successfully for many factory applications and in particular for those having many small induction motors widely separated and subjected to fluctuating loads. This type of factory faces the problem of production reliability and economy and correction improves these elements materially by doing three things:

(a) Enables the customer to reduce his power cost by reason of the rate clause.

(b) Improves the regulation on his motors by decreasing line drops and the effect of fluctuating loads.

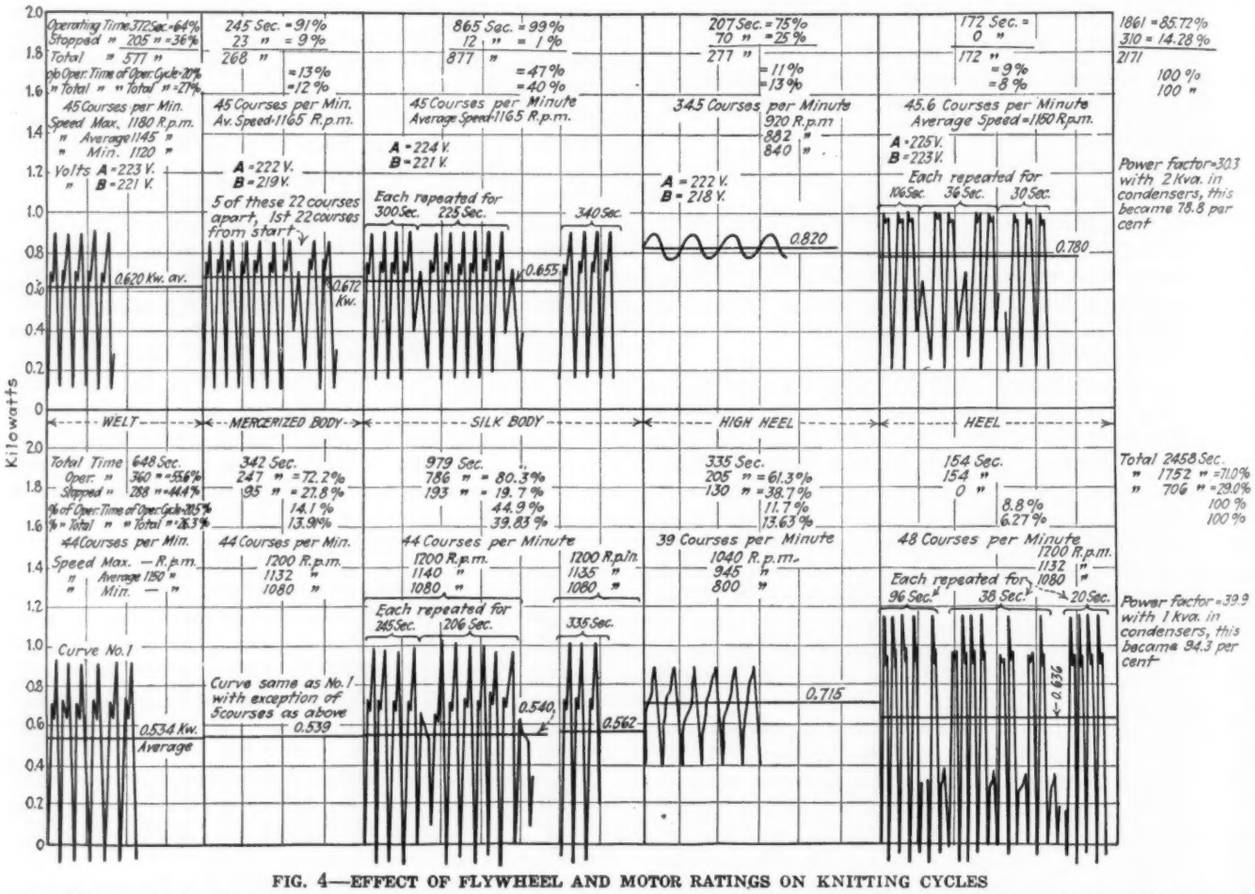


FIG. 4—EFFECT OF FLYWHEEL AND MOTOR RATINGS ON KNITTING CYCLES

(a) Duty cycle of a twenty-section Richter full-fashioned knitting machine equipped with two six-to-one flywheels and a Westinghouse 1½-hp., 220-volt, two-phase, 60-cycle motor, 1,110 r.p.m., 50 deg. C., type CW.

(b) Duty cycle of the twenty-section Richter full-fashioned knitting machine equipped with one four-to-one flywheel and a Westinghouse 1-hp., 220-volt, two-phase, 1,110-r.p.m., 40 deg. C., type CW motor.

(c) Use of machines with inherent low power-factor characteristics caused by a necessarily fluctuating load or duty cycle.

The use of rewound or old second-hand motors having poor characteristics is a very frequent cause of poor power factor and in other cases motors of the wrong size or type have been installed. Then again an injudicious use of individual drives may be the cause of poor power-factor conditions.

But the work requirements often dictate the use of individual motors of the induction type and very often the duty cycles are of a character to bring such fluctuating loads into play that a poor power factor results. Overmotoring should not be stressed too greatly in modern factories because it is extremely difficult to make an installation that will exactly and permanently provide the horsepower requirements under the changing production conditions in many factories. In many

(c) Improves the production characteristics of his machinery because smaller motors can be used, with consequent reduction in the mass required to be accelerated or decelerated during a duty cycle.

In addition a certain smoothing out of load changes occurs which gives more uniformity in machine operation.

7. The fundamental consideration in any system of correction is that the central station and the customer should receive financial benefit directly. But after correction has been made the indirect benefits resulting from more, better and cheaper production and smoother operation of the customer's equipment often outweigh the financial gains obtained by a decrease in the power bill of the customer.

8. Unit correction at motors can be instituted satisfactorily and should be applied intelligently more extensively in industry.

Relay Protection as Applied to Large Transmission Network

System Used by Pacific Gas & Electric Company Shows 95 per Cent Correct Operations Out of More than 1,500 — Scheme Is Based on Separation of Smallest Practicable Section of Network

By ROY WILKINS

Assistant Engineer Division of Hydro-Electric and Transmission Engineering, Pacific Gas & Electric Company

MANY years of experience in the operation of relays by the Pacific Gas & Electric Company indicate that the requirements of a relay scheme for a system network are that it shall separate completely the smallest practicable section of the network in such a manner as to give the least possible disturbance. The high-tension network operated by this company—a network which is perhaps the largest in the world—includes the following miles of circuit: 412 miles at 220 kv.,* 515 miles at 110 kv., 290 miles at 104 kv., 1,889 miles at 60 kv. and 160 miles of circuit at voltages not considered standard, such as 20, 22 and 30 kv. These lines connect twenty-eight hydro-electric plants and four steam plants, distributed as shown on the accompanying map over the northern portion of the State of California. Some idea of the size of the system may be gained from the map showing this system superimposed on the New England States.

All hydro-electric generating stations, all circuits above 17 kv. and all high-tension equipment in the substations connecting to them, including condensers and line-regulating equipment, are considered as composing the high-tension network of the company, and the relays described are incorporated therein. The standard generator connection is a grounded Y without resistance in the ground. Certain of the older 2,300-volt generators, however, are connected delta, and in one case different characteristics of generators on the same bus made it necessary to introduce ground resistance.

Power-house transformers are connected delta-Y, with the high-tension neutral solidly grounded, and most of the receiving transformers are connected Y-delta with the high-tension neutral solidly grounded. There is, however, an increasing number of auto-transformers Y-connected with the neutral solidly grounded on the system at the substation ends of transmission lines, particularly at the higher voltages. In order to conform to the state ruling on inductive interference these have a third or tertiary winding connected in delta.

ADVANTAGES OF RELAY SYSTEM

The advantages of the system of relay protection which has been developed by the Pacific Gas & Electric Company, and which is described herein, are as follows:

1. Single-phase grounds are removed very quickly and with a high degree of selectivity.

2. The system is applicable to single lengths in the transmission network as well as to one circuit of a pair of circuits or one circuit of three or four parallel circuits.

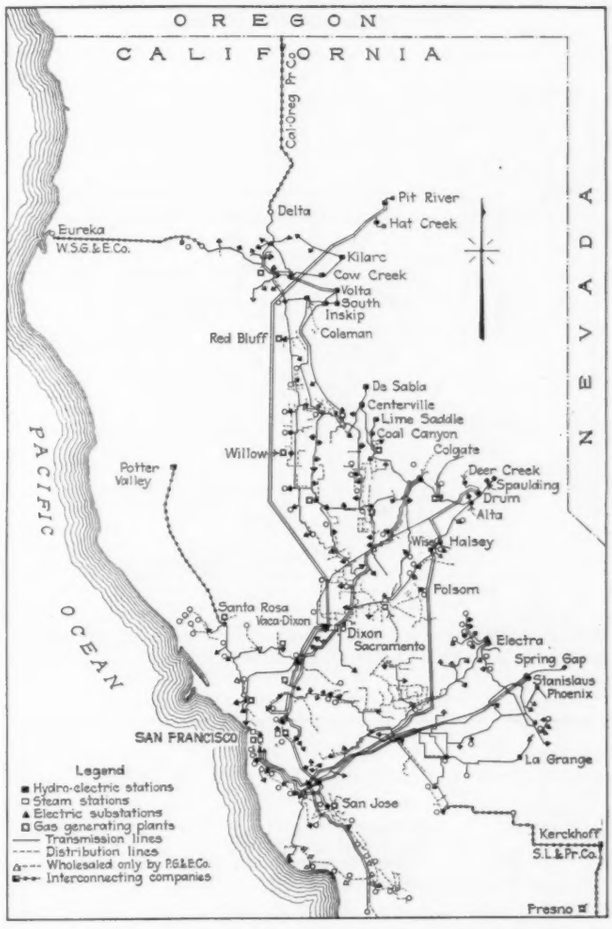
3. Experience shows correct operation even where a ground may be within 5 per cent of the length of the line from the far end.

4. No change in relays or character of protection is required when one circuit of a twin line is switched out.

5. It may be used with bushing-type current transformers.

From actual trials of virtually all proposed methods the system seems best taken care of by the following relays:

1. *Overload Induction Type.* — Used on single radial feeders, so-called "stub lines" (either with or without a



TRANSMISSION SYSTEM OF PACIFIC GAS & ELECTRIC COMPANY

*Only half of this mileage is now operating at 220 kv., i.e., one line from Pit No. 1 to Vaca substation. No. 2 line will be placed in operation at 220 kv. some time during 1925.

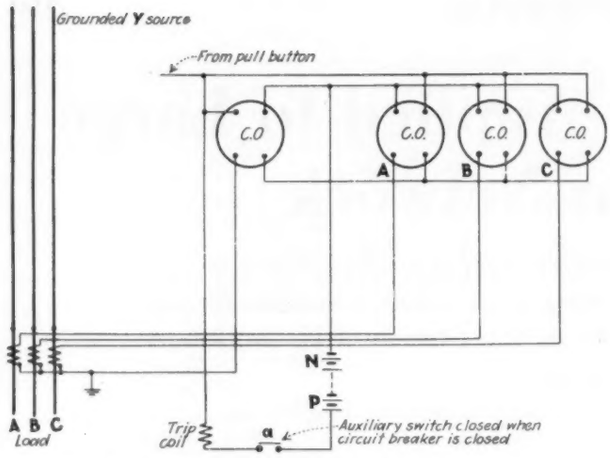


FIG. 1—CONNECTIONS FOR THREE CO RELAYS AND ONE RESIDUAL-CURRENT CO RELAY

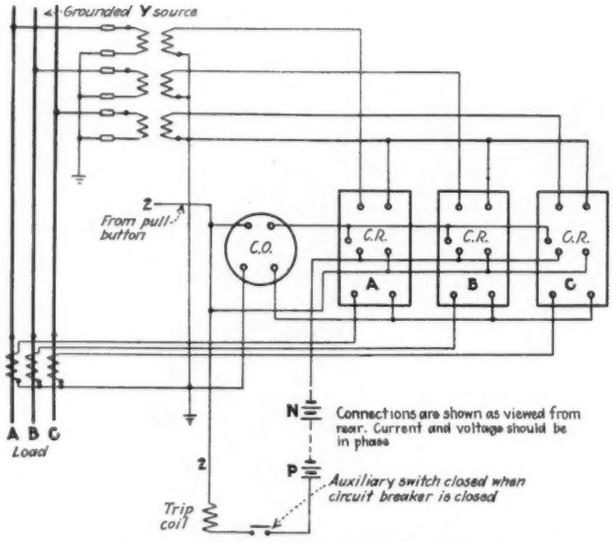


FIG. 2—CONNECTIONS FOR THREE SEVEN-STUD CR RELAYS AND ONE RESIDUAL-CURRENT CO RELAY

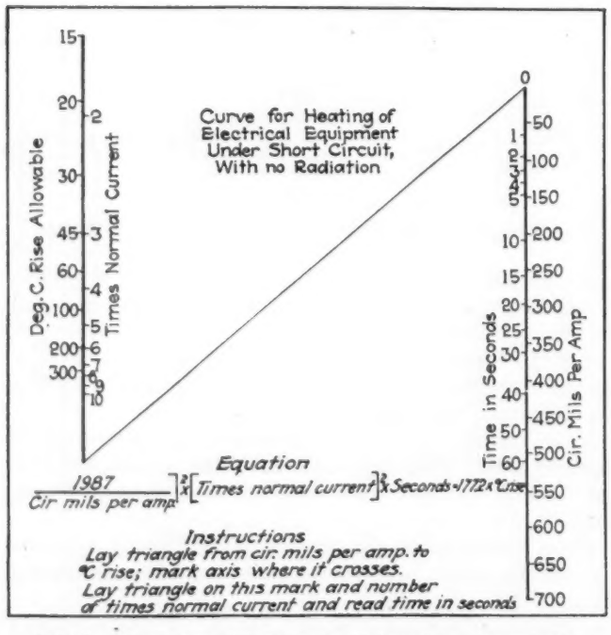

Curve for Heating of Electrical Equipment Under Short Circuit, With no Radiation
Deg. C. Rise Allowable
Times Normal Current
Time in Seconds
Cir. Mils Per Amp
Equation
1987 / Cir mils per amp]² x [Times normal current]² x Seconds = 1772 x Rise
Instructions
Lay triangle from cir. mils per amp. to °C rise; mark axis where it crosses.
Lay triangle on this mark and number of times normal current and read time in seconds

FIG. 3—CURVE FOR HEATING OF ELECTRICAL EQUIPMENT UNDER SHORT CIRCUIT WITH NO RADIATION

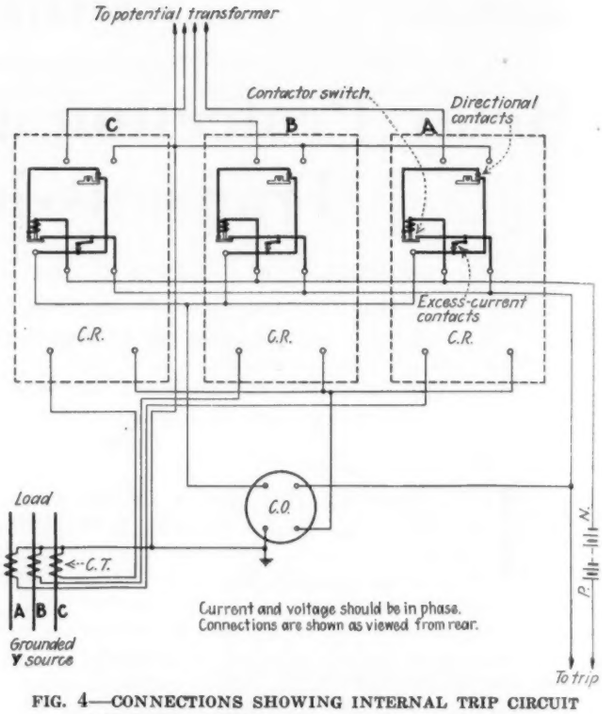


FIG. 4—CONNECTIONS SHOWING INTERNAL TRIP CIRCUIT FOR THREE SEVEN-STUD CR RELAYS AND ONE CO RESIDUAL RELAY

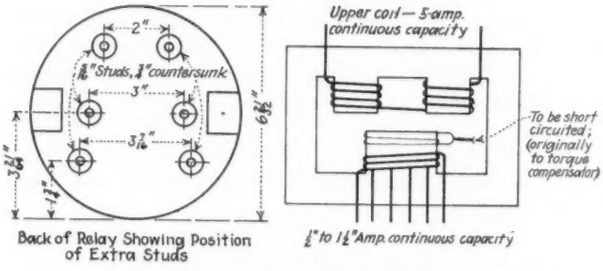


FIG. 5—TERMINAL LOCATION AND INTERNAL CONNECTION OF DIRECTIONAL CO RELAY

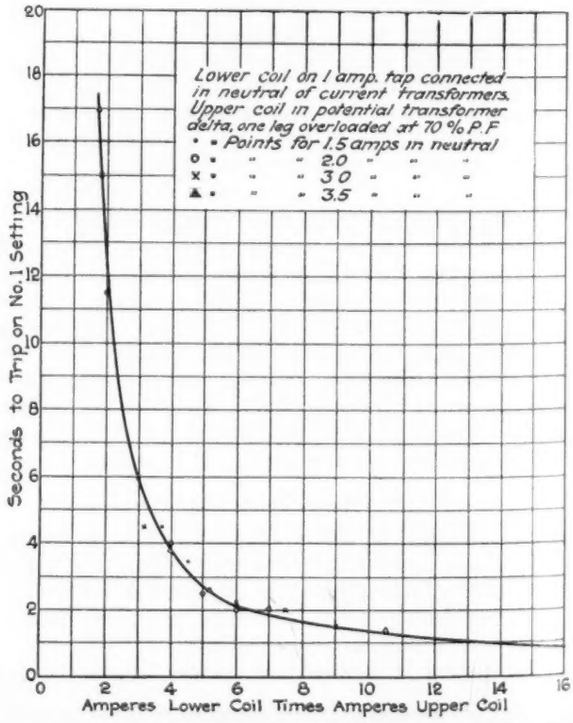

Lower coil on 1 amp. tap connected in neutral of current transformers. Upper coil in potential transformer delta, one leg overloaded at 70 % P.F.
• • Points for 1.5 amps in neutral
o • " " 2.0 " " "
x • " " 3.0 " " "
▲ • " " 3.5 " " "
Seconds to Trip on No. 1 Setting
Amperes Lower Coil Times Amperes Upper Coil

FIG. 6—PERFORMANCE CURVE FOR 0.5-AMP. TO 2.5-AMP. CO RELAY CONNECTED AS SHOWN IN FIG. 5

residual), on auto-transformers and on smaller tie lines such as 11-kv. lines tying parts of the system together.

2. *Differential or Balanced Type.*—On generators, synchronous condensers and two-winding transformers having a rating sufficiently large to warrant it.

3. *Reverse-Power and Residual Combinations.*—For receiving ends of transmission lines.

4. *Reverse-Power and Directional Residual Combinations.*—For the sending end of transmission lines.

5. *Directional Residual Relays.*—On ungrounded or delta-connected generators and feeders.

6. *Special Connections.*—To meet abnormal load or power-factor conditions or badly fluctuating loads.

The overload induction type in use at this time is of two general types—one operating on the same principle as the ordinary induction-type watt-hour meter and one using a shading coil. Both types are in use on the system. There is, in addition, a type under observation in which the disk revolves continuously and the operating mechanism is actuated only when the current reaches a predetermined value.

Inasmuch as a considerable portion of the relays are actuated from bushing-type current transformers operating at comparatively low currents, they are calibrated over all in place. The settings are on the inverse part of the time current curve and always above the minimum current at which the relay closes. They are in general made selective as to direction and amount of current, and in case of necessity to time, although the directional features seem to be the more reliable. Certain directional combinations involving only current have proved in service to be superior to those in which voltage, and consequently power factor, is involved, particularly where low settings are desired.

Functions of Various Types

1. In referring to overload relays it is to be noted that induction-type relays are specified. It is thought that any high-tension relay installation is of sufficient importance to justify the additional expense over the older types. High-tension current transformer secondaries are connected in Y and the simple overload connection is that usually used.

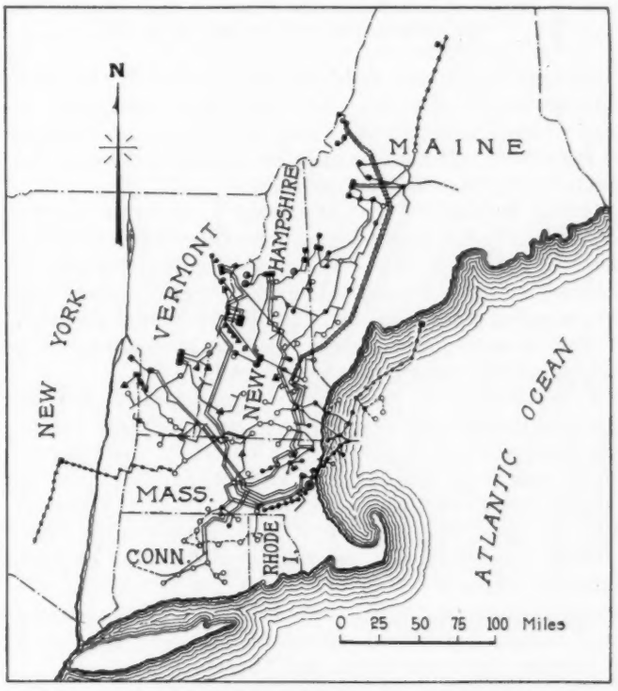
When it is desirable to separate on low values of unbalanced current or grounds, the residual relay is connected as shown in Figs. 1 and 2. By using a relay of a lower current rating very low values of grounds and unbalance may be taken care of, in most cases as low as 20 per cent of the normal load current.

On auto-transformers at the higher voltages overload relays on all windings have been preferred, first, because the various combinations of loading possible make some sort of maximum current rating for each winding imperative, and, second, because it is very difficult properly to balance a three-winding or four-winding transformer using bushing-type current transformers on the high-tension side and some other type on the low-tension side. Transformers are set within a maximum heating limit (see Fig. 3) with about 200 per cent normal current.

2. Differential or balanced type relays are used on all Y-connected generators and synchronous condensers, and all new equipment is specified to be Y-connected. Here the current transformers are duplicates, having similar characteristics, and instantaneous plunger-type overload relays are commonly used, set to trip on a current unbalance of about 20 per cent of full load.

The power-house transformers are usually protected by differential relays in order to withstand heavy overloads without clearing and still clear on internal trouble. Trouble has been encountered in balancing where current-transformer characteristics were different. This can sometimes be helped by balancing in the magnetic circuit of the relay itself, using from, say, zero to the 4-amp. tap for one current transformer and from the zero to the 6-amp. tap for the other, connected in opposition. On delta-Y banks it is customary to connect the low-tension current transformers inside the delta to insure correct phase relations.

3. Reverse-power and residual combinations are in general used on the receiver end of transmission lines. The connections in such an installation are shown in Fig. 4. Both the current and voltage on the reverse-power relays are Y-connected and they are in phase.



PACIFIC GAS & ELECTRIC NETWORK IN NORTHERN CALIFORNIA SUPERIMPOSED ON NEW ENGLAND STATES

The residual is set at from 20 per cent to 50 per cent of normal load current, and both are set to trip in a direction out from the substation, i.e., back toward the power house.

4. Reverse-power and directional residual combinations are used on the sending ends of transmission lines, either from a power house or substation. If a relay of the common type has its two windings separated as shown in Fig. 5, it will act as a wattmeter whose windings are such as to be actuated by current transformers with characteristics shown in Fig. 6.

If it is then connected as shown in Fig. 7, it will act as a residual, but in addition will have a direction dependent on the relative direction of power flow in the ground lead of the transformer and the residual of the current transformers.

For trouble on a line the power flow may be considered from the line into the ground and back up through the ground lead of the transformer bank. In this case the direction up into the bank from ground is the same wherever the ground on the line occurs, but the direction of residual of the current transformers depends upon whether the ground is on their bus or their line side.

This gives a standard direction for one coil of the

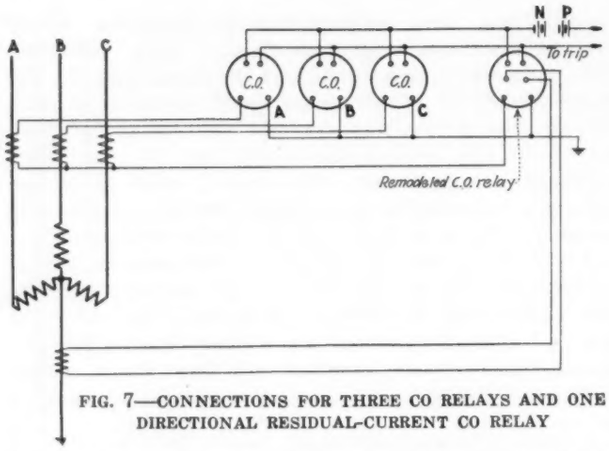


FIG. 7—CONNECTIONS FOR THREE CO RELAYS AND ONE DIRECTIONAL RESIDUAL-CURRENT CO RELAY

relay and a variable direction, depending on the location of the trouble, for the other, both operating on current alone and operating only when there is a ground or unbalance. It can, in addition, in most cases be set much below the normal line current.

It will be noticed that the relay connections on the sending end of a transmission line differ from those on the receiving end. This is due to the fact that at the sending end of a transmission line the relays must trip for outgoing power and the watt or directional elements of the reverse-power relays will be normally closed, making of the relays simple overloads.

A residual relay operating in conjunction has no directional features and must be made directional as described above. It is desirable to retain the reverse-power relays on the sending end of parallel lines to prevent the power which feeds back from the system over the good line clearing it also in case of trouble.

On the receiving end the watt or directional element contacts normally stand open, and for trouble in the direction that it is desired to trip these contacts must close. A residual connected as shown in Fig. 4 is selective as to direction and therefore used.

The combination of schemes three and four works

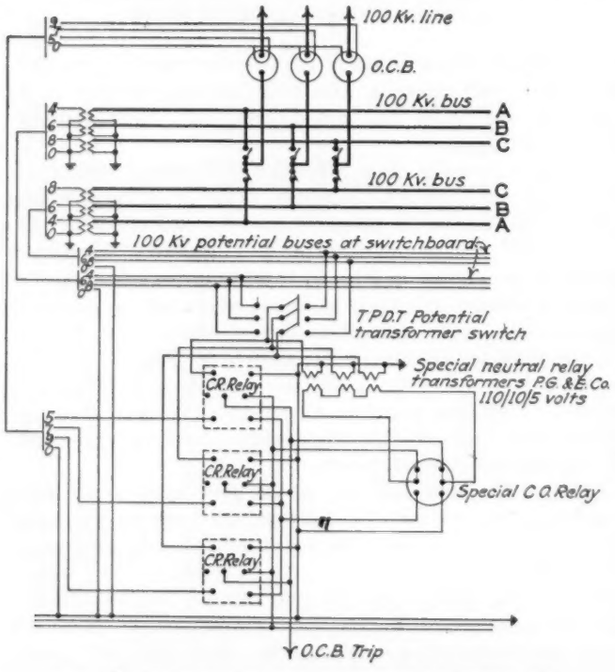


FIG. 8—CONNECTIONS FOR COMBINED OVERLOAD AND RESIDUAL-CURRENT DIRECTIONAL RELAYS

equally well whether there is one line or several lines in operation, each line being independent of all others. It also allows tapping stations on the line between the two ends without interfering with selective operation.

On the sending ends of certain lines, as at a substation where power is outgoing from an autotransformer and the transformer ground is not available or is unsuitable, a small 110/5-volt transformer bank is connected in Y to the potential transformer secondaries, which are also connected in Y. The primaries of this small transformer bank are Y-connected and the neutral is grounded (see Fig. 8). The 5-volt side of this small bank is connected delta, with the coil of the relay, which is usually connected to the current transformer in the transformer ground, in series with the delta.

This miniature bank functions just as a large one save that care must be exercised in order to get a very low setting, say 20 per cent of normal, if the line current transformers are of bushing type and of comparatively low ratio. Considerable less than normal current settings can always be obtained, however. This combination as used is shown in Fig. 8.

In most combinations of the schemes outlined it can

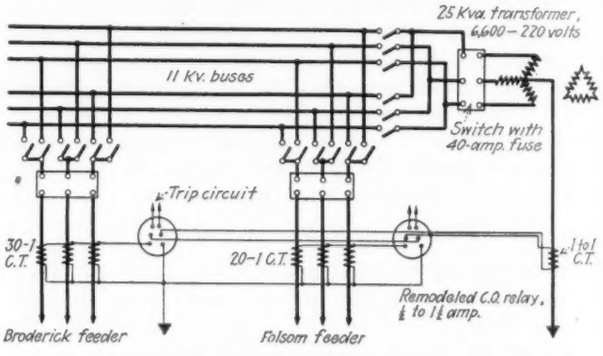


FIG. 9—CONNECTIONS FOR DIRECTIONAL CO RELAYS FOR DIRECTIONAL RESIDUAL-CURRENT FEEDER PROTECTION

generally be stated that the relays should trip on power outgoing from the station (see Fig. 10).

5. Certain feeders on the network are delta-connected and ungrounded. It is desirable to separate these feeders promptly on very light grounds, and this is accomplished as shown in Fig. 9, using a 25-kw. grounding bank. As shown, the bank is fused. In practice it was found necessary to relay it for overload at a high value for a moderately short time. As installed, the feeders act selectively on grounds of 15 amp. and have given correct selective operation on 350-amp. grounds.

During one month that an electrically operated dredge was worked off a cable fed by one feeder there were thirty-three correct operations out of thirty-three cases of trouble in thirty days where the current to ground ranged from 20 amp. to 350 amp. In two years of operation there has been but one operation classed as questionable. This same combination (see Fig. 9) is applicable to ungrounded equipment such as generators and works equally well whether there is one or more than one feeder.

6. In certain installations, particularly in interconnected substation lines, it has been found that sufficient damping cannot be secured on the watt or directional element of the reverse power relay and still give it effective operation. In such cases it has been necessary to interconnect the watt and current element

of the relay, as shown in Fig. 11, in such a manner that the current element only starts to close after the watt element is completely closed. This is accomplished by putting the watt element contacts in series with the top coil of the current element, leaving the winding connected to the current transformer intact.

In certain cases it has also been necessary to provide for a low tripping current in one direction and a comparatively heavy load current in the opposite direction. This has been taken care of by building a small reactance and shunting it directly across the relay-current studs.

At low current values the relay takes nearly all of the current and so can be set for a low reverse value, while at higher values of incoming power the point of saturation on the reactance is passed and most of the current flows through it.

A ratio of two or three to one can thus be obtained. The equipment should be calibrated under working conditions, and any changes in current settings on the relay require a new calibration.

In other cases widely differing settings are desired and it is arranged to have a miniature "ratio changer" on the relay taps. Such special cases are only encountered occasionally and must be taken care of in the particular manner that the case demands.

On the greater number of the system relay installations it is desirable to ring a bell and light a pilot lamp when a relay operates in addition to the primary function of tripping switches. This is done by using a secondary relay, usually a plunger, hand-reset, multiple-contact, circuit-closing type. From experience it has been found that it pays to use the best obtainable.

NECESSARY CONDITIONS

In order to obtain successful relay operation some questions, enumerated below, had to be answered by actual trial.

(a) The possibilities of bushing-type current transformers came first. These transformers make a high-tension relay system possible and have proved, if properly applied, thoroughly satisfactory where currents above 80 amp. are available.

It is advisable always to use relays of a low energy consumption on bushing-type current transformers, with especial emphasis on low-ratio transformers† Low-ratio current transformers should not have the secondary overloaded either in volts or volt-amperes. A high-impedance secondary load is fatal to bushing current transformer ratios.

On the system network bushing-type current transformers are calibrated over all in place by applying current from a 110/220-10 volt transformer through the lead itself or oil-switch terminals. Each time a current setting is changed this is repeated. Ammeters and indicating wattmeters are in satisfactory use on bushing-type current transformers but should preferably have a separate transformer from that used for the relays. These instruments are purchased with blank scale and are calibrated in place in the same way as the relays with the addition of a phase shifter to secure the proper wattmeter potential.

Any changes in the load on the current-transformer secondary—i.e., more or less meters—make it necessary to recalibrate, and if meters and relays share a transformer, any changes in relay-current setting make a recalibration necessary.

(b) It has been found by trial that the best operation on the system is had by connecting the current and potential of the reverse-power relays in phase. This is probably due to the fact that at light loads there is a very low leading power factor, but under short circuit a comparatively high lagging power factor.

†There are in satisfactory use on the system bushing-type current transformers on transformer terminal bushings where the laminations were cut from sheet steel, assembled on the bushing and wound in place.

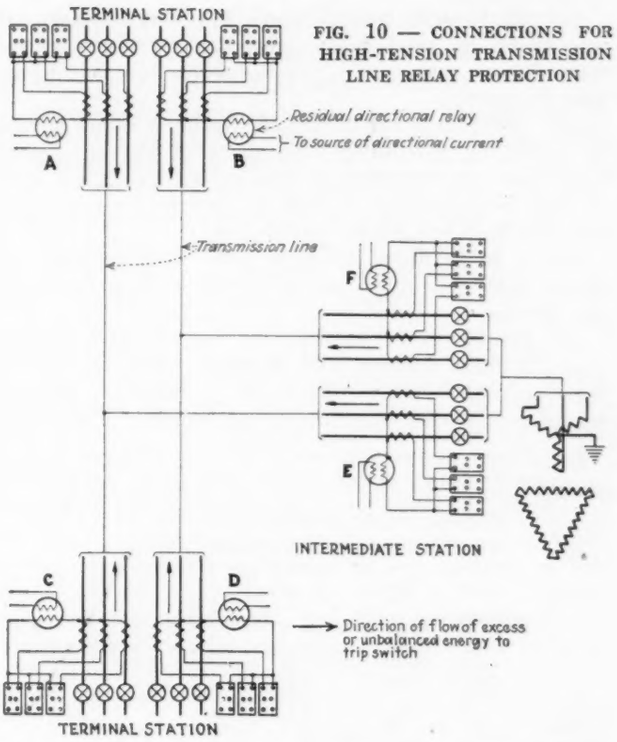


FIG. 10 — CONNECTIONS FOR HIGH-TENSION TRANSMISSION LINE RELAY PROTECTION

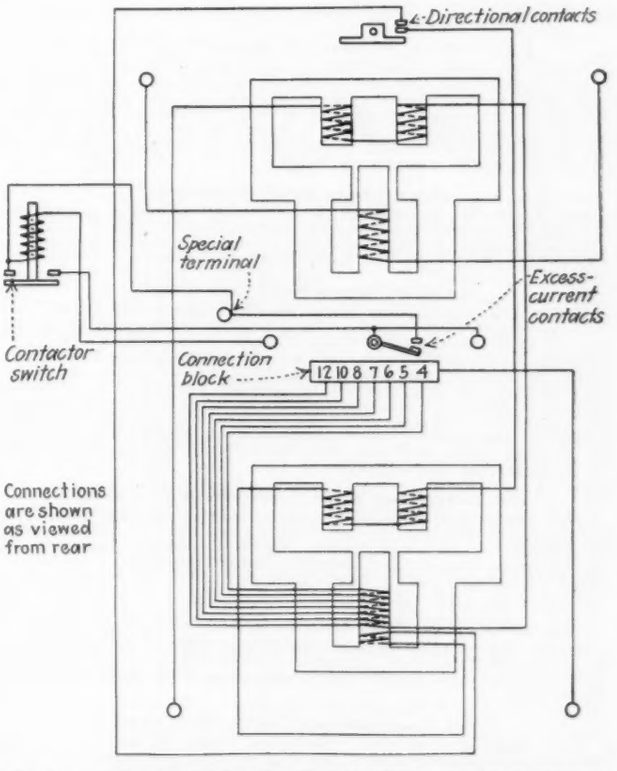


FIG. 11—INTERNAL-CONNECTION DIAGRAM FOR WESTINGHOUSE SEVEN-STUD CR RELAY WITH CURRENT ELEMENT CONTROLLED BY WATT ELEMENT

(c) All reverse power relays are single-phase. It was found by trial that a three-phase reverse-power relay did not necessarily reverse when only one phase was in trouble.

(d) Differential and directional residual relays should be tested by grounding one phase of the equipment under test and building up voltage until sufficient current is generated at normal frequency to trip. No other method has proved satisfactory.

(e) It is desirable to have relay test switches so that a relay may be cut out of service without changing any wiring.

(f) Proper phase relation of current and voltage —i.e., A-phase current with A-phase volts—is vital to reverse power relay operation. Checking polarity marks or a wiring diagram is not sufficient. The customary method is to use a single-phase wattmeter and apply successively the different voltages to one current. (See *A. I. E. E. Journal*, 1924, P. C. Jones, "Wattmeter Connections.")

Not all of the schemes and methods outlined above are essential, nor are they the only means of accomplishing the desired results. They are, however, accomplishing these results on one of the largest high-tension networks in existence in a fairly satisfactory manner as the chief load dispatcher's statement of 95 per cent correct relay operations on the high-tension network for the year just past, shown in the accompanying table, bears witness.

ANALYSIS OF RELAY OPERATION ON THE 220-KV., 110-KV. AND 60-KV. TRANSMISSION NETWORK OF THE PACIFIC GAS & ELECTRIC COMPANY FOR YEAR 1923*

(See explanation below)

	1	2	3		4 Incorrect Relay Operations				5	
	Relay Failures (No Operation of Switch)	Total Relay Operations No.	Correct Relay Operations No.	Per Cent	Due to Relay No.	Per Cent	Due to External Causes No.	Per Cent	Questionable Relay Operations No.	Per Cent
January	0	124	122	98	0	0	2	2	0	0
February	1	87	86	99	0	0	1	1	0	0
March	0	104	91	88	3	3	5	4	5	5
April	2	110	106	96	0	0	4	4	0	0
May	4	149	138	92	0	0	10	7	1	1
June	2	152	141	93	5	3	6	4	0	0
July	1	129	125	97	0	0	3	2	1	1
August	1	154	153	99	0	0	1	1	0	0
September	4	203	196	97	0	0	3	1	4	2
October	1	77	76	99	0	0	1	1	0	0
November	4	127	122	97	0	0	3	2	2	1
December	4	153	134	87	3	2	1	1	15	10
Total	24	1,569	1,490	95.0	11	0.70	40	2.53	28	1.77

* Including leased properties.

EXPLANATION OF ANALYSIS OF TRANSMISSION

Col. 1—Relay Failures (No Operation of Switch)

Under this heading are listed all cases where subsequent investigation has proved that conditions at the point in question were such as to permit correct relay operation but the relays failed to function. No case is listed as a relay failure if investigation proves the trouble to be due to a break, ground or other fault in the direct-current tripping circuit, or to mechanical defect in the switch or auxiliary apparatus external to the relay itself.

Col. 2—Total Relay Operations

This tabulation includes all cases of relay operation causing the opening of oil switches and is a summation of Cols. 3, 4 and 5. (Note—Cases of relay operation due to accidental shorting or closing of contacts are not included in this report.)

Col. 3—Correct Relay Operations

Under this heading are listed all relay operations which have been proved to be correct under the conditions existing at the time. This tabulation includes many cases which were not entirely satisfactory from an operating standpoint, but where, owing to load, voltage and power-factor conditions, it was necessary to give the relays credit for correct operation, even though the results were not precisely as desired. There are also included in this table a number of cases in which unsatisfactory relay operation has occurred due to inadequate equipment. (See Col. 4.) In all these cases, however, the relays themselves functioned correctly under the circumstances.

Col. 4—Incorrect Relay Operations Due to Relay

This tabulation includes all cases that have been proved by subsequent investigation and test to be due to faults, either mechanical or electrical, in the relays themselves. (Note—This classification does not include relay operations which were apparently faulty because of inadequate equipment or improper connections.)

Col. 4—Incorrect Relay Operations Due to External Causes

Under this classification are listed all cases of relay operation which investigation has shown to be the result of faults or improper connections in auxiliary apparatus external to the relays themselves.

Col. 5—Questionable Relay Operations

This table covers relay operations which it has been found impossible to classify under Col. 3 or 4. In most cases the operation has been unsatisfactory, but owing to the lack of evidence it was considered unfair to classify it as incorrect, particularly as a test made after the trouble showed the relays to be operating correctly so far as could be determined.

Letters from Our Readers

Applications of Wheatstone Bridge to Underground Cable Testing

To the Editors of the ELECTRICAL WORLD:

In your issue of September 27, page 687, appeared an article by Victor Truant of Paris, France, entitled "Locating Faults in Underground Cables," the method used being the application of the Wheatstone-bridge principle but without any instruments except a length of German-silver resistance wire and a sensitive galvanometer. The good conductor of a cable is connected to the defective or grounded conductor at the far end, and the resistance wire is connected across the two station ends. By the use of the galvanometer and a sliding contact on the wire a point is found where the needle comes to rest, which is relatively at the same place on the wire as the place of the ground on the cable. Of course, this seems simple enough and perfectly obvious today, and the simplicity and accuracy of the method are what recommend its use as at present in Paris.

I believe, however, that I was the first to make use of the method in central-station work almost thirty-four years ago, and I reported it in the *Electrical Engineer* (later merged with the ELECTRICAL WORLD) on February 18, 1891, editorial comment being made in the issue of February 25 in that year. This was in Bilbao, Spain, where the first Thomson-Houston direct-current central station having an underground three-wire cable system was installed. The cables were Siemens concentric three-conductor armored cables laid in a trench without conduits. BYRON T. BURT.

New York, N. Y.

Compensation and Self-Respect of Employees Are Interrelated in Industry

To the Editors of the ELECTRICAL WORLD:

Thank you for the eminently sound editorial entitled "Loyalty Can't Be Bought, but It Can Be Bankrupted," in the October 18 issue of the ELECTRICAL WORLD.

The remarkable financial success of electric utilities recently, together with the growth of customer ownership of securities, may have obscured for the moment the importance in the permanent success of this industry of the attitude of the employee toward his company. An essential to effective service by an employee is self-respect. For a trained utility employee to represent the company to leaders in other industries and

be conscious of an earning power no greater than that of the average skilled workman in these other industries is to place a strain upon his self-respect. Before loyalty comes self-respect, and before either comes a generous disposition on the part of the employer. In America generosity is not to be confused with paternalism. Competitive industry has learned that the greatest incentive to effort, self-respect and loyalty is reward. Non-competitive industry will learn the same lesson.

Northern Indiana Power Company, Indianapolis, Ind. DEAN M. TAYLOR, Power Engineer.

Load Transference Between Alternators in Parallel by Field Excitation Inadvisable

To the Editors of the ELECTRICAL WORLD:

The communication from Shawinigan Falls, Quebec, in the ELECTRICAL WORLD for November 8 entitled "Load Transference Between Alternators in Parallel" makes it pertinent for us to say that on our extensive system all transference of load between plants or alternators operating in parallel is done entirely by variation of speed or driving force. It would, however, be very interesting to us to see a load of 10,000 kw. transferred from one machine to another by varying the field excitation.

A. P. BROADHEAD, Superintendent of Power.
Associated Gas & Electric Companies, Oneonta, N. Y.

To the Editors of the ELECTRICAL WORLD:

In the ELECTRICAL WORLD of November 8 I note a letter on "Load Transference Between Alternators in Parallel." The writer of this article appears to have met with a rather common difficulty, and the question is well worth a discussion.

To vary the load on an alternator the control valve or governor must be manipulated to change the amount of steam or water admitted to the prime mover. On a large transmission system this will not change the alternator speed, but will change the share of the load carried by this machine. It may be advisable to change the field excitation to improve the performance, however. Altering the field excitation will change the proportion of leading or lagging current carried by the alternator, but will not greatly change the actual load.

In support of the above statements, which I have verified by test, may I quote a portion of Alexander Gray's "Principles and Practice of Electrical Engineering," page 260:

"If two alternators are operating in parallel, an increase in the excitation of one machine raises the voltage of that machine and tends to make it carry more of the load. But the machine cannot slow down and allow the engine to take more steam because it can run only at synchronous speed. An increase in excitation on one machine therefore increases its voltage and at the same time makes the current in that machine lag further behind the voltage so as to maintain the load $EI \cos \alpha$ constant at the value corresponding to the steam supply. To change the distribution of load between alternators operating in parallel, the governors of the driving engines must be manipulated so as to change the distribution of the steam supply."

I trust that this will clearly answer the question raised by Mr. St. Maurice. I am inclined to favor the practical operators in their statements as against the statement made by the dean referred to by Mr. St. Maurice.

ROGER T. WAITE.
Hartford, Conn.

New Haven and Ford Electric Locomotives Compared

To the Editors of the ELECTRICAL WORLD:

In responding recently to the request to comment on the electric locomotives recently ordered by the New York, New Haven & Hartford Railroad and to be built by the General Electric Company, I did so in the spirit of a past and present interest—a past interest because of my old association with the New Haven in charge of its electrification, a present interest because I was keenly interested in the type of engines ordered, having just prior to that order suggested urgent reasons for their consideration. The new New Haven locomotives are to be of the motor-generator type. Alternating current will be taken from the overhead-contact lines and fed to a synchronous alternating-current motor installed within the cab of the locomotive, directly connected to a direct-current generator, which in turn will deliver current of that type to the driving motors.

I am very glad to have now the opportunity afforded me by the ELECTRICAL WORLD to say a word or two about the electric locomotives designed for operation on Henry Ford's railroad. The Ford locomotives are of Westinghouse design, ordered prior to those recently ordered by the New Haven railroad, and are also of the motor-generator type. Accordingly, I shall be as keenly interested to note their performance as the performance of those which were recently ordered by the New Haven.

I think the profession and railway management are much to be congratulated that these two most interesting types of locomotives will be placed in operation shortly. It is my hope, and also my belief that that hope will be realized, that the fullest publicity will be given to the facts to be developed in respect to the physical and economic characteristics of these engines. In my opinion, we are, or should be, on the threshold of standardization of the contact system for railways electrifying. We have faced and settled the matter of standardization in respect to electric power transmission, and it is my belief that we are in duty bound, in the public interest, to settle it in the railway field as well.

An interesting point has been brought up in reference to the overhead system for Mr. Ford's road carrying 22,000 volts, while the voltage of the New Haven is 11,000. I cannot "clapper-claw" with this an instant. Rather would I applaud the courage of Ford and the Westinghouse Electric & Manufacturing Company. There is no reason, with proper insulation, why 22,000 volts should not be practicable unless the accompanying fixed charges more than offset the money value of the current distribution losses saved by the use of the higher potential.

It is to be remembered also that in the case of the Ford locomotive a fully assembled set of units (four in number) calls for the collection of 5,000 hp.—something like two and a half times that for double-unit locomotives (the maximum) operating on the New Haven. However, 22,000 volts and 11,000 volts will be potentials easily negotiated by the same engines, as the transformers on the engines need only be designed to permit their primary coils to be operated in series or in parallel, depending on whether 22,000 volts or 11,000 volts is respectively the potential of the contact system.

WILLIAM S. MURRAY.
New York, N. Y.

Central Station and Industrial Practice

Over-All Test of Induction-Type Relays

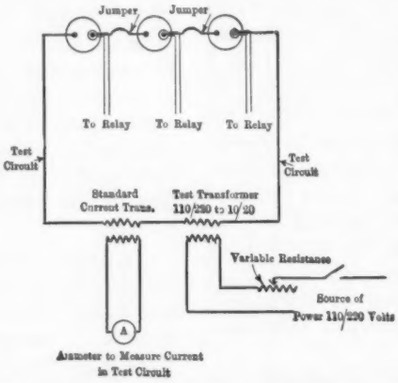
By N. P. Carlsen, Jr.
Assistant to Engineer of Operation,
Pacific Gas & Electric Company,
San Francisco

In the development of the bushing-type current transformer it was found that the volt-ampere capacity available was limited and that the ratio was not always dependable. This difficulty was overcome by developing a low-energy induction-type relay and by compensating the coils. The compensating of the coils did not entirely overcome the ratio trouble, but by testing the relays over all any doubt as to exact ratio is eliminated.

For over-all testing of relays a set has been developed by the Pacific Gas & Electric Company consisting of a low-voltage, high-current transformer, a carbon pile and measuring instruments, together with other necessary accessories. The connections for this equipment are shown in the accompanying illustration. In over-all testing it is necessary either to cut the circuit breaker involved out or by-pass it, after which the disconnecting switches are opened, entirely clearing the breaker. By-passing a breaker necessarily means that the line is connected through an air switch to the bus and is no longer protected. This is not desirable, and on the larger systems a double bus is used with a bus-tie circuit breaker that can be used to replace any line breaker during an over-all test. This permits the taking of sufficient time to make a thorough test of all parts of the breaker as well as the relays without subjecting the rest of the system to possible interruption.

In making the actual test after the breaker has been disconnected from the circuit, all three phases of the breaker are connected in series, by means of extra flexible cables of approximately No. 4/0 copper and portable clamps, to the test transformer which is set up at the base of the breaker. The primary of the test transformer, which in reality is a small sign-lighting transformer with a secondary current-carrying capacity of 800 amp., is then connected by means of a No. 10 flexible duplex lead through the carbon pile and a switch to a source of 110 volts or 220 volts. Owing to the necessity of having the carbon pile as close to the relays under test as possible, it is sometimes necessary to have as much as 500 ft. of cord. Another No. 12 flexible duplex cord is run from the switchboard to a standard current transformer which is connected in the series circuit passing through the breaker. At the switchboard the No. 12 duplex is connected to a portable ammeter of a 5-amp. to 10-amp. range.

Before performing the test the relays are opened and inspected and, if necessary, cleaned. When the inspection is completed, the circuit breaker involved is closed, the trip circuit cut out and current applied by closing the source of supply and building up on the carbon pile. The primary current applied to the breaker is read directly on the portable ammeter. The setting for the relay is usually determined in advance, depending upon load conditions on the circuit involved. After passing sufficient current to rotate the disks of the relays the current taps of the relays are adjusted to the proper position for the setting desired. The current at which the relay is to trip is then applied and the closing of the contacts timed. When the current and time settings have been made, the trip circuit is cut in and the breaker is tripped by applying tripping current. This causes all parts of the breaker to perform and tends to show up any trouble that may occur outside the relay.



WIRING DIAGRAM FOR OVER-ALL TESTING OF INDUCTION-TYPE RELAYS

The actual tripping time of the breaker is measured by means of a cycle counter connected across the breaker. This eliminates time lost in auxiliary relays and mechanical motions. This method also permits the ready checking of polarity of current transformers which is essential for reverse-current residual combinations of relays. All new relay installations receive a complete test, using the above method, before they are cut into service.

Automatic Cooler Controls Generator Air Temperature to 1 Per Cent

Automatic control on generator air temperatures is being provided at the 3,500-kw. Boone plant of the Iowa Railway & Light Company by means of five recording instruments. This automatic control is obtained by means of two coolers—one main and one auxiliary—in the closed air-cooling system for the generator. Recording instruments were installed because, the plant being in an isolated region, continuous records could thus be kept without requiring an engineer to run out from Cedar Rapids to maintain good operation. By means of these records the operating attendant can readily learn to keep the plant running at maximum efficiency.

The principal advantages of a closed system for air-cooling generators are:

1. Transference of the heat of the outgoing generator air into the condensate and raising the temperature from 10 deg. to 15 deg.

2. Reduced fire danger because of the small volume of air, thereby tending to smother a fire due to the generation of CO_2.

3. Reduced operating cost, because no expensive air-conditioning system is required, the same air being recirculated continuously.

4. Lower first installation cost, because no fans and auxiliary equipment are necessary.

Briefly, the design of the control system is divided into two units—the main cooler and an auxiliary cooler (Fig. 2). The main cooler

takes the water directly from the condensate, which is heated by the generator air and then passes on to the hot well. The cooling water in the auxiliary cooler is taken from the circulating water of the condenser and discharges into the sewer. Control of operation is through a

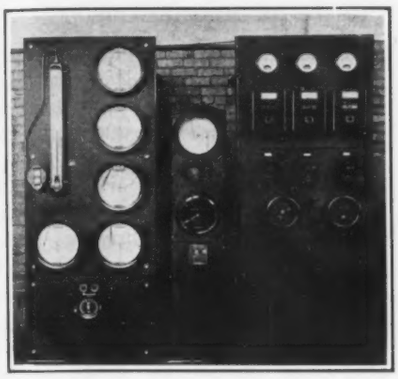


FIG. 1—CONTROL PANELS ADJACENT TO ENGINEER'S OFFICE AFFORD ACCURATE CHECK OF OPERATING CONDITIONS

motor valve under 15 lb. air pressure in the water-supply line to the auxiliary cooler. As long as the temperature of the air leaving the generator does not get higher than the predetermined points set on this controller the auxiliary coolers do not function. This condition is desirable in order to derive benefit from one of the advantages of the closed-air system, which is that the condensate is heated by the air discharged from the generator. However, when the load becomes so great that the capacity of the main coolers is not sufficient to cool the air and keep it below 138 deg. to 140 deg. F., or any other predetermined temperature, the auxiliary coolers are automatically brought into service by means of this motor-controller valve. As soon as the load changes and the main coolers can handle the air supply correctly the auxiliary coolers automatically are removed from service by means of the motor valve.

A test run showed that this controller actually holds the discharged-air temperatures within a total variation of less than 1 per cent. With this installation it is necessary to use a control valve which will stay open should the air pressure fail. Accordingly a reverse-acting control valve and a direct-pressure head on the instrument have been used. Further protection is provided through the use of hot-spot bulbs for an indicating thermometer which measures the hottest point of the air duct. This thermometer is in the engineer's office and has an electric alarm attachment. When the temperature reaches a predetermined maximum temperature, indicating an approach of the danger point, a bell is rung warning the operating engineer. This set point would, as a rule, be several degrees beyond the main control point on the automatic temperature controller for the auxiliary cooler. Thus the bell indicates the presence of trouble on the auxiliary cooler.

For effective control in this generator the five indicating instruments used are the following:

1. Recording thermometer ranging from 30 deg. to 220 deg. F., with two pens for incoming and discharge air temperature of generator (Fig. 2A).

2. Recording thermometer ranging from zero to 150 deg. F., with two pens for inlet and outlet water temperature to main cooler (Fig. 2B).

3. Recording thermometer ranging from 30 deg. to 220 deg. F., with three pens for inlet and outlet water temperature for condenser water and turbine exhaust (Fig. 2C).

4. Recording thermometer ranging from 30 deg. to 220 deg. F., with two pens controlling all temperatures to and from main bearings (Fig. 2D).

5. Temperature-pressure recorder ranging from 200 deg. to 800 deg. F., zero to 300 lb. steam pressure (Fig. 2E).

All these instruments are mounted on the operating panel shown in Fig. 1. From charts taken from these recording instruments the efficiency of the main cooler can easily be checked since it shows the difference in air and water temperatures before and after leaving the coolers.

Direct checking of the similarity in variations for all of the instruments enables a very accurate analysis to be made of operating conditions. A study of the charts absolutely checks up any faults of operation. Thus a means of determining operating errors is provided. This equipment was installed in November, 1923, by the Foxboro Company, Foxboro, Mass., at a cost of less than $1,500.

Operation has been so successful that portions of the equipment are being duplicated on two 10,000-kw. units at Cedar Rapids. John M. Drabelle is mechanical and electrical engineer.

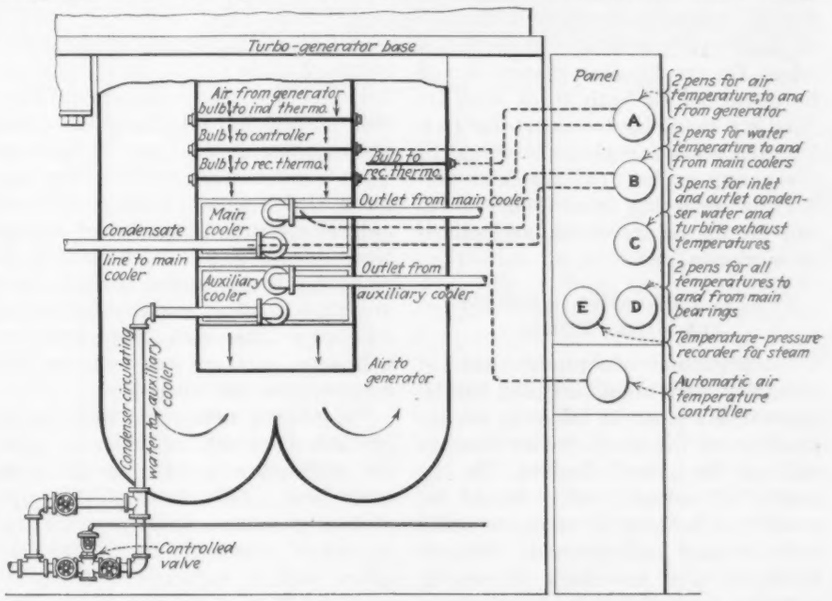

Turbo-generator base
Air from generator bulb to ind. thermo.
Bulb to controller
Bulb to rec. thermo.
Bulb to rec. thermo.
Outlet from main cooler
Main cooler
Condensate line to main cooler
Auxiliary cooler
Outlet from auxiliary cooler
Air to generator
Condenser circulating water to auxiliary cooler
Controlled valve
Panel
A
B
C
E
D
2 pens for air temperature, to and from generator
2 pens for water temperature to and from main coolers
3 pens for inlet and outlet condenser water and turbine exhaust temperatures
2 pens for all temperatures to and from main bearings
Temperature-pressure recorder for steam
Automatic air temperature controller

FIG. 2—SCHEMATIC LAYOUT OF MAIN AND AUXILIARY COOLERS AND INSTRUMENTS

Color and Stencil Identify Transformer

BY J. HILL, JR.
Assistant General Superintendent Southwestern Gas & Electric Company, Shreveport, La.

TO FACILITATE ready identification of transformers in the storeroom as well on the pole lines, the Southwestern Gas & Electric Company paints its transformers three distinctive colors and also applies stenciled symbols on the front and two sides to indicate the company number and rating. The figures are made 2 in. to 3 in. high so that they can be readily discerned

from the ground, the first number indicating the company number and the second number the rating of the transformer in kva. The corresponding stencil numbers are also painted on the transformer hangers, so that they may be easily identified in the stockroom when a transformer has to be hung. Standard three-wire, 110/220-volt transformers are painted black; the 440-volt transformers are painted red, and some odd types, of which there are still a few in use on the system are painted green to distinguish them readily.

The combination of these means of identification has been helpful in sorting the transformers in stock, drawing them out of stock, identifying them on the pole lines, and in eliminating odd types from the distribution system. The stenciling is particularly helpful because the nameplates many times become detached or the information thereon obliterated.

Safety in Mine Electrification

Transmission of Energy Underground, Best Voltages to Use, Insulation Problems and Secondary Feeder Lines Discussed

SAFETY problems encountered in the electrification of mines were discussed by J. B. Johnson, mechanical engineer United Verde Copper Company, before the National Safety Council at Louisville on October 1. The transmission of electrical energy underground differs quite radically from methods employed on the surface. Perhaps the most common trouble in underground power transmission lies in grounds. The only remedy lies in placing special emphasis upon first-class construction and a choice of first-class and suitable insulating materials. Next in importance comes the institution of a rigid inspection system with tests at least every month. Bare trolley wires for the haulage system should be protected on both sides with insulating material to clear the trolley, and tests for grounds should be frequently made. The accidents frequently occurring from trolley wires can usually be traced to carelessness of workmen.

Special Insulation Necessary for Mine Feeders

Underground clearances are of necessity very small, so that special precautions must be taken in the insulation of the main feeder lines as well as the branch feeders. In the matter of voltage, safety would demand that nothing in excess of 6,600 volts be used underground. Seldom, however, is it necessary to employ voltages over 6,600, and unless an underground transmission line is unusually long—more than 2 miles—the standard line voltage of 2,200 is sufficient. It is a safe rule to run these 2,200-volt lines direct without any transformation to all alternating-current motors of 50 hp. and over. Insulation of main feeder lines carrying 2,200 volts can be made perfectly safe if jute insulation with a lead-sheet covering and flexible armor is used. This is a standard insulation produced by all leading manufacturers. Although costly, it will pay for itself in the prevention of accidents due to short-circuits or grounds. This method has the further advantage of being waterproof and flexible, so that it can be anchored direct to timber sets or walls. Metal sheaths are proof against stray conductive currents.

Danger from Moisture When Iron Conduit Is Used

A less costly method consists of a standard cable run in metal conduits, but this has many objections from the standpoint of safety. Chief among these is the item of moisture from condensation within the conduits. Whenever local conditions necessitate such a method of insulation, adequate provision should be made for trapping the moisture and draining it off at suitable intervals; otherwise the collecting moisture will soon rust out the interior and disintegrate the insulation.

In splicing armored cable special precautions must be taken to make the stiff splice as safe as the main cable line. This is usually accomplished by using a short piece of pipe of ample diameter to confine the splice and a reducing bushing at each end to close the end of the pipe, thus allowing the cable to pass through. Copper is spliced by soldering in the usual manner, taped and then a good quality of heated insulating compound poured into the pipe, thereby completely filling it and excluding all air.

Problems encountered in the insulation of vertical feeder mains, oftentimes several thousand feet long, are radically different from those met with in surface transmission lines, according to Mr. Johnson's discussion.

Preventing Cables from Slipping in Mine Shafts

In the first place, nearly every mine having different levels utilizes the hoisting shaft for the location of the feeder lines to transmit power to these various levels, and in the second place it is very important to secure the conductors to the sheaths so as to prevent slipping when hung vertically. Lead-covered, steel-armored cable is now manufactured with bands every 8 ft. or 10 ft. apart to prevent this slippage. The top anchorage should be made secure enough to support at least 800 ft. of cable, and sufficient steel armor must be bent away from the cable to make an effective bond in the supporting clamp. Secondary clamps can then be placed around the cable at every level to keep the cable in place. To prevent the communication of fire in the shaft, the cable should be confined to the small fireproof compartment, or if the shaft does not permit this room, the cables should be fireproofed by covering with a fireproof coating.

Another method of hanging feeder circuits is by installing vertical conduits within a concrete-lined shaft. It has been Mr. Johnson's observation on one installation that after less than four years' service the entire cable had to be replaced, because it was found that there were a number of grounds all along the shaft where the insulation had been punctured. In this particular case the insulation was of rubber, which is poor insulation material for underground use in a dry mine.

Connecting Distribution Feeders to Main Circuits

The same precautions must be exercised in the distributing feeders. Connections of distributing lines to main feeders in a shaft should be made in steel junction boxes in the same manner as in surface work. The box should always open on the outside of the shaft wall and into the station. The grounding of all metal armor and sheaths, conduits, boxes and transformer cases is as important in underground work as in surface work, since the safety standpoints are the same. However,

this precaution is frequently overlooked owing to the underground difficulty of finding suitable ground connections. The safest method is to connect all ground currents to a continuous metallic return to the surface, either through shaft or tunnel, and connect up to a good system of grounding plates in a suitable location. This is far better than the all too common practice of connecting to a water main in a shaft.

Overcoming Coal-Pile Fires

BY J. W. MACKENZIE
Operating Mechanical Engineer Consumers Power Company, Jackson, Mich.

MANY years ago some of the best engineers in the country were advocating that all coal should be stored below water. At that time one company constructed a concrete pit of great size for storing about 8,000 tons in this manner. At present, however, the same plant is storing from 20,000 tons to 30,000 tons of coal and considers the pit of no value whatsoever.

While the storage of coal under water will entirely overcome coal-pile fires, it does not by any means eliminate all the troubles due to coal storage, as the reclaiming cost of coal stored under water is often greater than the losses resulting from fires. Not only does the watered coal decrease the furnace efficiency, but the continual submerging of the coal-handling equipment below the surface of the water greatly increases the maintenance cost of the coal buckets or other equipment. Furthermore, in cold weather the coal will freeze in storage and reclaiming is very difficult and expensive. When the wet coal is deposited in open bunkers, it will freeze again, making it very difficult to transfer it to the power plant and distribute it among the various boilers.

Any one who has had experience with coal-pile fires will agree that a stream of water from a hose is of little value for putting out the fire. The small amount of water which will reach the heated part of the coal pile will only be turned into steam, This will tend to spread the fire rather than put it out.

Up to the present time the best known method of combating a coal-pile fire after it has started is to dig the fire out as soon as the coal has shown evidence of heating. In case actual fire is encountered during the handling of the coal, it can be quenched in small quantities by means of a hose line.

Modern power plants are being designed to prevent the fires rather than for combating them. Storage space is provided in such a way that coal can be stored over a large area in depths not to exceed 12 ft. to 15 ft., as shown in the illustrations. Most coal gives no trouble when stored in this way. Where it is necessary to store the coal in greater depths, it has been found that Eastern coal gives less trouble than West or Middle Western coal. Most of the coals from West Virginia and eastern Kentucky give very little trouble from firing when they are placed in storage.

Although the Bureau of Mines has stated that the presence of sulphur has no effect upon the spontaneous combustion of coal, it has been the experience of the writer that those coals which are low in sulphur give considerably less trouble from heating in storage. This, of course, may be due to some other condition than the mere presence of sulphur in the coal.

Ventilation of coal piles has not generally been found advantageous, for while it undoubedly permits much of the heat to be carried away, it also lets in fresh air to the center of the pile, which is likely to increase combustion.

TYPICAL COAL-STORAGE YARDS WHERE 12-FT. DEPTHS HAVE REDUCED DANGER OF FIRES TO A MINIMUM

Low-Voltage Protection as a Source of Trouble

BY J. A. VANDERPOLL
Assistant Field Engineer Westinghouse Electric & Manufacturing Company, New York

FOR a number of years it has been a practice, generally accepted, to protect motors from damage due to undervoltage by equipping circuit breakers with low-voltage coils. The protective apparatus is usually arranged in this manner: A coil is connected to the voltage of the line side of the motor breaker. The coil, when energized, holds an iron core against an iron yoke. When the line voltage drops under a certain amount (usually around 60 per cent) the coil will release the core. The falling core unlatches the breaker and the motor is disconnected from the line. This arrangement has been made such a common practice that, although it has been the cause of numerous unnecessary shutdowns of whole plants, causing tremendous losses, it is still being installed on almost any motor above 5 hp.

The cause of the shutdowns is that the line voltage of the central-station companies is subjected to "dips." The dips in turn are due to short circuits or switching in the transmission system.

Here is the point where the trouble started for many central-station companies. As soon as a power consumer had a shutdown he would complain to the central-station company that he had to suffer losses because of inadequate service. Some of the central-station companies felt that it was partly their fault and were even willing to go to some expense in order to try to satisfy the consumer. Others felt that they could not do very much and found that the consumers after a number of shutdowns would get accustomed to them and refrain from complaining.

A large power company in the East

went so far as to rewind all its customers' low-voltage coils. The object was to make the breaker trip at a lower voltage (12 per cent). This diminished the number of shutdowns, but at the same time it endangered the motors as it decreased the low-voltage protection. Other companies went even further and encouraged the elimination of the low-voltage protection.

The writer believes that in an effort to satisfy their customers the central-station companies went too far because the power companies cannot eliminate the "dips." It is true that by building a transmission system properly protected it is possible to diminish the number of "dips," but it is impossible to eliminate them.

The remedy is that, first of all, the power companies should educate their customers to the fact that dips are unavoidable. The length of a dip is, as shown on graphic meters, usually only a fraction of a second, so that in the lighting service it is hardly noticed, if noticed at all. Second, the power companies should inform their customers that in most cases the shutdowns can be avoided. Third, they should inform the consumers that the instantaneous low-voltage protection is not desirable for motors that are essential to operation.

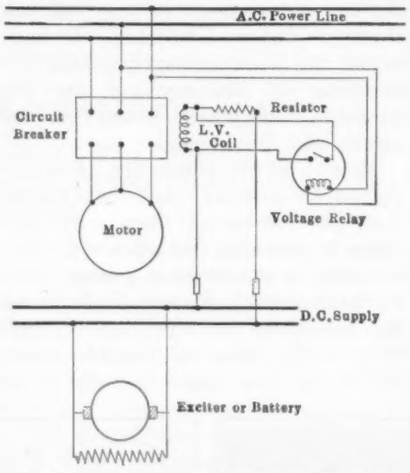
The solution of the difficulty is a time-delay, low-voltage protection installed at the expense of the consumer. As the consumer pays for a low-voltage protection, which should protect his motors against voltage dips, it is self-evident that he should pay also for an adequate time-delay protection.

MEANS OF PROTECTION

It is comparatively simple to install the time-delay, low-voltage protection on synchronous motors. It is equally simple to equip similarly any kind of motors where a reliable direct-current supply, such as a battery, is at hand. Usually a 12-volt battery suits the purpose.

The means necessary to convert a low-voltage coil into a time-delay, low-voltage protection consist of a reliable direct-current supply (exciter or battery), a resistance tube and an undervoltage relay. The relays of the induction type at present on the market are very reliable and do not need attention. The price is conservative. In case a 12-volt battery is used a special low-voltage coil is necessary.

The low-voltage coil is disconnected from the alternating-current supply and connected in series with a suitable resistor across the direct-current supply. The resistor must be of such a size that the low-voltage coil receives the same or less direct current than the rated alternating current for the coil. The voltage coil of the low-voltage relay is connected on the line where the low-voltage coil was connected previously. The relay should start closing its trip-circuit contacts when the line voltage sinks



TIME-DELAY LOW-VOLTAGE PROTECTIONS WITH RELAYS

under 60 per cent. The relay trip-circuit contacts should be connected across the low-voltage coil.

When the voltage drops under the specified amount the relay will start its trip contacts toward closing. When the voltage remains low it will short-circuit the low-voltage coil in one or two seconds, thus tripping the motor breaker. It is evident that under the usual dips of transmission systems the breaker will not trip out. Only the prolonged low voltage or lack of voltage will disconnect the motor from the line. This is exactly the protection that is needed.

This arrangement has been installed in a number of plants and functions very satisfactorily. Central-station companies would eliminate a serious source of trouble in their relations with customers by recommending adequate arrangements for the time-delay, low-voltage protection.

Cleaning Circulating-Water Intake Screens

BY R. D. GILLESPIE
Plant Superintendent Dayton Power & Light Company

WHEN rotating screens are equipped with water jets in the ordinary manner, the Dayton Power & Light Company has found that it is impossible to keep them clean at certain times of the year. The flushing apparatus ordinarily provided is adequate for removing most obstructions, but paper, filmy material and the like adhere so firmly that it is difficult to remove. Consequently at the Miller Ford station on the Miami River the water pressure for the jets, which is maintained at 100 lb., is supplemented by air pressure at 110 lb. By mixing the air with the water the latter comes through the jets in spurts, thereby removing, very effectively, any filmy obstructions that may be present.

Diesel-Engine Operation in Arizona

BY S. HEADMAN
Manager Tucson Gas, Electric Light & Power Company, Tucson, Ariz.

OPERATING with an installed capacity of 3,210 kva. in five Diesel oil engines, the Tucson Gas, Electric Light & Power Company in 1923 generated 7,538,640 kw.-hr. at a total cost per kilowatt-hour distributed of 1.07 cents. During this period the peak load was 1,980 kw., which produced an average annual plant factor of 26.8. The fuel consumed was 716,818 gal. with an average B.t.u. per gallon of approximately 144,000.

Despite the erroneous supposition that maintenance on old Diesel engines would be high, the maintenance expense for 1923 on five engines ranging in age from three to eight years totaled only 1.3 cents. This utility furnishes power to a territory totaling 20,000 people, with a 2,300/110/220 - volt, three - phase service.

The itemized operating expenses are as shown in the accompanying table.

Installed generator capacity, kva.		3,210
Station output kw.-hr. for twelve months ended Dec. 31, 1923.		7,538,640
Peak load in kw.		1,980
Annual plant factor		26.8
Fuel, gal.		716,818
Average B.t.u. per gallon, cents.		144,000
Average price of fuel per gallon, cents.		5.69
Operating expense per kw.-hr. distributed, cents:		
Fuel	0.553	
Wages and superintendence	0.243	
Water, lubrication, supplies, excluding taxes, insurance and depreciation	0.145	0.941
Maintenance expense per kw.-hr. distributed, cents:		
Station building and structure	0.05	
Prime movers and auxiliaries	0.04	
Generators and electrical equipment	0.03	
Miscellaneous equipment	0.01	0.13
Size of prime movers:		
One 500-hp. Fulton, purchased in 1915.		
One 500-hp. Fulton, purchased in 1916.		
One 520-hp. Busch-Sulzer, purchased in 1918.		
One 520-hp. Busch-Sulzer, purchased in 1920.		
One 925-hp. Werkspoor, installed August, 1923.		

Central Station Business

Leaving Meters Connected Brings Good Will

FOR some time the Arkansas Central Power Company, Little Rock, has been leaving meters connected after customers have moved, as a convenience to new tenants, who would be delayed in obtaining electric service if they had to sign an application first. This practice has been followed because it is realized that the light and other conveniences made possible by electric service are most essential in every household the first night, although new tenants often forget to make application for service until they are actually faced with need of it.

The Arkansas company calls the attention of new tenants to the availability of electric service by means of tags, like the ones shown, attached to the main switch, which is opened when an old customer moves, and similar tags attached to electrical fixtures here and there. Four things are printed on one side of these tags, namely, (1) "Electric service"; (2) "Close this switch to restore light"; (3) "Yours for service," and (4) "The Arkansas Central Power Company." It is also explained that the meter has been left in service for the customer's convenience. The customer is requested to call at the utility office as soon as possible to sign an application for service. Advantage is taken of the other side of the tag to ask if the customer needs lamps. He is informed that a full assortment of lamps is carried by the utility company and that they will be delivered if the customer will call the lamp department of the utility company (telephone number given). At the same time the application will be obtained, if not already signed. The customer is informed that he may pay for the lamps with the next month's bill. The practice described has been very helpful to the company in inspiring good will.

ELECTRIC SERVICE!
Close This Switch to Restore Light
This meter has been left in service for your convenience. Kindly call at our office as soon as possible and sign an application so our record will be completed.
"YOURS FOR SERVICE"
Arkansas Central Power Company
115 West Fourth Street
Phone 4-7980
Do You Need Lamps?
We carry a full assortment of Edison Mazda Lamps for your convenience. If you need any lamps, call 4-7980 Lamp Department, and we will deliver same, and secure your application for service, if not already signed. You may pay for lamps with next month's bill.
Arkansas Central Power Company
115 West Fourth Street
Phone 4-7980

CARD ATTACHED TO SERVICE SWITCH AND FIXTURES IN VACATED HOUSES TO NOTIFY NEW TENANTS THAT METERS ARE CONNECTED

Meters are not left connected indefinitely. By an analysis of conditions in Little Rock it has been found that residences which are vacated are empty forty-five days on the average. As a safety factor the meters are left connected ninety days after a customer vacates the premises, only the main switch being opened and tagged as previously mentioned. The meter is read upon discontinuance of service and also, if accessible, every month while the house is vacant, to ascertain if energy is being used. By following this practice the cost of removing and reinstalling meters is eliminated and the expense of keeping cut-out and cut-in records in the meter department is saved. The truck-hours and man-hours required for meter installations have been reduced about one-half. About $6,000 to $7,000 was saved last year from this item alone.

While there is a possibility that energy may be used without payment when the house is vacant by workmen or even by tenants who may never apply for service—the loss this way has been very small; in fact, hardly sufficient to reduce appreciably the saving effected. When a new customer makes application for service, a meter reading is taken and the customer is billed with that reading as a starting point. If, however, through the monthly meter reading a new tenant who has not applied for service is found to be using energy, he will be charged for all used since the last reading. It has been found that very few customers will argue the point if they have been lax in applying for service.

The Arkansas Central Power Company has been considering whether it will inform new tenants by means of the meter tag that an initial meter reading will be taken if application for service is made immediately upon entering the house, whereas the last meter reading will be taken as the starting point if this be not done.

Annuity Plan Provides for Employee Retirement

UNDER a service annuity plan made effective by the Northern Indiana Gas & Electric Company on November 1 male employees who attain the age of sixty-five years and female employees who attain the age of sixty years while in the service of the company will be eligible for retirement with a pension.

The annuity for each employee retired will be an amount equal to 2 per cent of the average annual salary for the period of his or her continuous service to the date of retirement, multiplied by the number of years of service, but not to exceed an amount equal to 50 per cent of the employee's rate of pay during the last year of service. The maximum pension will be $3,000 a year.

Men over sixty-five years of age and women over sixty years of age at the time of the adoption of the plan will have their annuity computed upon the number of years of service up to this date and therefore will have the same standing as employees who shall attain those ages while in service after the plan becomes effective.

Men who attain the age of sixty and women who attain the age of fifty-five while in service may be retired on an annuity upon request, provided they have been in the service of the company continuously for twenty years or more. The percentage of the final rate of pay for maximum annuity for those who retire voluntarily will range from 40 to 48 per cent instead of 50 per cent.

Employees of the company make no payments into the annuity fund as the company will maintain the fund and the payments of pensions as a reward for long and faithful service.

The adoption of the service annuity plan by the Northern Indiana Gas & Electric Company is another important step taken in the interests of employees since Samuel Insull and his associates assumed the management of the company a little over a year ago.

Modern Lighting Studied in High School

TO PROVIDE a practical method of instructing students and members of the electrical industry in the fundamentals of illuminating engineering an installation of lighting units comprising virtually all commercial and industrial types was recently made in one of the science rooms of the Cass Technical High School, Detroit, at a cost of approximately $2,500, by the Electrical Extension Bureau of Detroit, supported by the Detroit Edison Company. The installation includes a total of fifty lighting units, a large number of wall brackets and numerous outlets for floodlamps and spotlamps, and in addition a special demonstration box has been constructed to illustrate the effects of color, glare, shadows, different intensities and new and unusual show-window arrangements.

Among the fifty units are nine special composite fixtures, each of which is designed to demonstrate the principal types of lighting—inclosing-diffusing, inclosing-light-directing, semi-indirect and totally indirect. This is made possible by the arrangement of lamps and reflectors in the single bowl, which includes one 400-watt lamp, two 200's, one 150, one 100, three 50's and five 75's.

The Cass Technical High School is said to be the largest institution of its kind in the world, with an enrollment of several thousand students each year who are combining vocational training with their high-school courses. The installation was made primarily for their benefit and for the benefit which is expected to accrue to the industry as a result of teaching these thousands of young people the fundamentals of proper industrial and commercial illumination. Arrangements have been made with the Michigan chapter of the I. E. S. to have an expert give the students a course of lectures each session.

It was also agreed that the local electrical extension bureau may use the installation at any time when regular classes are not occupying the room and that members of the bureau may even bring customers there to give them demonstrations of different types of lighting and lighting units.

At this time the electrical extension bureau is using the installation to good advantage by giving a class of forty-four jobbers' salesmen, contractor-dealers and central-station men a course in illuminating engineering under the direction of James M. Ketch, resident illuminating engineer of one of the large manufacturers.

Other uses for the installation will be to demonstrate to local merchants and to retailers' associations and conventions the proper application of window-lighting equipment, color screens, floodlamps, and so on.

It was necessary, of course, to obtain the permission of the school board to install the equipment in a public school building, but no difficulty was met in obtaining such permission from the Detroit school board. Electrical organizations or central-station companies in other cities might cite this as a precedent in broaching the matter to their school boards.

Several Byllesby Properties Going Into Merchandising

IT IS indicative of the generally revised attitude of electric service utilities that several Byllesby properties in different sections of the United States are seriously considering or have already embarked on the merchandising of electrical appliances. This is particularly significant in view of the fact that the Byllesby Engineering & Management Corporation, like a number of other companies a few years ago, was reluctant to merchandise for several reasons. Among them was the recognition that merchandising departments could not be conducted and still retain public good will unless servicing facilities were provided. The good will of contractors and dealers was and is highly valued and no practice is countenanced which will break down this good will. Besides, merchandising in former years was attended by large cash losses due to the attempt to conduct the business primarily on a load-building basis alone and not on a strictly merchandising basis.

Although no definite action has been taken by the executives of the Byllesby company to promote aggressive merchandising on all properties, they are no longer prohibiting merchandising by individual companies so long as methods are adopted which will not entail the objections previously outlined.

LEFT—CLASS OF ELECTRICAL MEN TAKING COURSE IN ILLUMINATING ENGINEERING. RIGHT—LIGHTING UNITS INSTALLED IN CASS "TECH" HIGH SCHOOL, DETROIT

KANSAS ELECTRIC POWER COMPANY'S WELL-APPOINTED SALESROOM AT EMPORIA

Value of a Salesroom to the Central Station

CENTRAL-STATION companies which do not operate a retail salesroom miss two good chances for profit, according to Ralph Smalley, district manager of the Kansas Electric Power Company at Emporia. The sale of electrical appliances by the central-station company, he believes, offers, in the first place, a handsome profit upon the appliances themselves, and, second, each appliance installed in a customer's home increases the load on the company's lines.

Interviewed recently by a representative of the ELECTRICAL WORLD, Mr. Smalley was asked to outline his company's general policy with regard to the sale of appliances and explain something about the methods of selling. Mr. Smalley's statement in reply is quoted directly, for it carries an outline of logical central-station merchandising practice which should be of interest to other executives. He said:

"It isn't hard to sell appliances if you have a well-appointed salesroom and offices. You will note that we have paid particular attention to the appearance of our appliance salesroom. We have an advantage over other retail electrical stores, for at least 25 per cent of the population of Emporia is represented in the office once a month. We carry a full line of electrical goods, display them attractively, and thus create a desire for them in the minds of the women who come in regularly to pay their bills. Once you create a real desire for an article and re-enforce it with frequent display and with newspaper advertising, you have gone far toward selling it. In this connection I would say that our customary allowance throughout the whole company is 5 per cent of the gross income for advertising.

"We have been particular to build convenience and comfort into our salesroom. It is roomy and commodious. We have easy chairs for the women and have provided tobacco stands for the men. There are comfortable corners where those who meet by accident may sit down for a chat, and we encourage customers to make themselves quite at home in our office. In fact, many women have formed a habit of making appointments to join their friends here if they are to meet somewhere downtown. Every minute a customer spends in our office gives our merchandise a chance to sell itself by auto-suggestion.

"Some central-station companies have hesitated to make their offices comfortable and attractive, fearing that any display of luxury might cause patrons to believe that they were paying for this 'splurge' in their lighting bills. We have experienced no reaction of that sort. In fact, our customers in Emporia seem to feel that the company is an asset to the town and that because the citizens of the town patronize the company it should be able to afford a good-looking office. As a matter of fact, many of our customers have brought out-of-town visitors into our office just to show them what a fine lighting company they have.

"The sale of electrical appliances is, by no means, a side line for the company, as it is made to stand on its own feet and pay a profit. Of course, every appliance sold increases the energy consumption, but this simply gives us a double interest in developing a thriving retail business. We do not believe that any central-station company can afford to abandon the sale of appliances in the hope that a sufficient number will be sold by other dealers. This usually works out poorly for every one concerned, and, as a matter of fact, in the long run electrical contractor-dealers actually sell fewer appliances under that practice than if they had fair and active competition from their local central-station companies."

Utility Forms Personal Service Department

IN ORDER to determine the customer's viewpoint toward utility services, the Missouri Gas & Electric Service Company, Richmond, Mo., has created a personal service department. This department will be in charge of Miss Jean Ward, who will visit all of the company's residential customers, talk with the housewives and seek complaints and suggestions regarding the company's service. All complaints will be turned in to the trouble department and remedied as soon as possible. Any apparatus and appliances needing repairs will be taken care of at the home or brought in for adjustments. Information is given each customer on meter reading, replacing fuse plugs and care of appliances. No attempt will be made to sell any commodity directly, but information and advice as to any specific appliance will be given, and these "prospects" will be followed up by authorized salesmen.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Conditions Affecting Steam-Turbine Economy.—J. Y. DAHLSTRAND.—The author outlines the conditions which interfere with maintenance and high economy in the operation of steam turbines. Internal leakage, nozzle corrosion and the action of foreign substances on the blades are considered.—*Power Plant Engineering*, Oct. 15, 1924.

New Byllesby Plant Near Muskogee.—Unusually detailed data accompany this illustrated description of a 22,500-kw., 63,000-volt station in Oklahoma, equipped to burn either coal or oil.—*Power*, Oct. 7, 1924.

Aberdeen-Laxapana Hydro-Electric Scheme, Ceylon.—As a result of stream gagings since 1917 a number of sites for hydro-electric developments have been fixed upon, totaling about 600,000 hp. Work on the largest of these, estimated at 200,000 hp., is to be undertaken at once. The present article describes the plan, with maps and views.—*Engineering* (*England*), Oct. 3, 1924.

Turbines.—The work of the sub-committee on turbines of the prime movers committee of the N. E. L. A. as recounted in its serial report has been the accumulation of operating history on large units in service, analyses of which are presented in detail. The data indicate that the industry today demands more from the apparatus than in the past. Many conclusions of value may be drawn affecting decisions on new installations. The report is divided into six parts: 1923 turbine operating history, 1923 composite service record, 1923 system use of large turbine units, trend in new installation work, definitions of terms used, and manufacturers' statements.—*Publication No. 24-57 of the N. E. L. A.*

Generation, Control, Switching and Protection

Transformer Oils.—FRITZ HOEG.—The author discusses the various factors which influence the quality of oil for transformer purposes. The results of certain recent investigations by the author and certain European electrical manufacturers are reviewed. Of special interest is the fact that a strong electric field has been found to accelerate the formation of sediment under certain conditions. This effect does not take place at the lower temperatures, however. In one instance, reported by the A. S. E. A. Company in Sweden, a tension of 25,000 volts, impressed for a period of six months, during which the oil temperature was maintained at 90 deg. C., caused a very heavy deposit of sediment. Owing to these results, the author maintains that the influence of the electric field should be taken into account in the testing of transformer oils.—*Meddelelser fra Norske Elektricitetsverkers Forening*, October, 1924.

Dissipation of Heat in Turbo-Generators.—C. SYLVESTER.—Tests for determining the amount of heat dissipated at various points of a turbo-generator are described. The heat dissipation in any part of a turbine should be known at all times in order that the highest efficiency obtainable may be reached.—*Electrical Times* (*England*), Oct. 23, 1924.

Transmission-Line Problems with Special Reference to the Arc-Suppressing Reactor.—S. BEKKU.—The author shows that a solution of various transmission-line problems can be easily reached by the symmetrical co-ordinate method. A graphical method of solution has been developed for use when there is saturation. The performance of the arc-suppressing reactor is treated in terms of the symmetrical co-ordinates, the general quench condition having been obtained. The theory of the arc-suppressing reactor has been developed for the case of a symmetrical three-phase transmission line of uniformly distributed line constants. It was found that the quench condition is independent of the position of ground. The method of measuring impedance of the power source is described in an appendix.—*Research No. 129 of the Electrotechnical Laboratory, Tokyo, Japan.*

Transmission, Substations and Distribution

Alternating-Current Underground Distribution in New Orleans.—In the October 25 issue of the ELECTRICAL WORLD, on page 903, a Digest item appeared stating that in the new alternating-current system which is being installed in New Orleans the alternating-current substations will receive power at 13,200 volts and that it will be stepped down to 4,000 volts, three-phase, four-wire, the distribution voltage. This statement was in error since one of the chief features of the new system will be the elimination of distribution substations, the energy being transmitted at 13,200 volts directly to the distribution transformers and then being stepped down to 115/200 volts, three-phase, four wire.

Economic Load Distribution in Converter Substations.—V. D. ROHDE.—In substations containing several rotaries of various sizes considerable savings may be achieved by judicious load distribution among the various machines, running in parallel for a given load demand. The author has developed and describes in this paper an extremely simple, graphical method to determine the most economical load distribution in such substations. With this basic method tabulations are established and efficiency curves are drawn which give in a single reading all the necessary factors to determine the best load arrangement for any given demand upon the station. In a number of practical examples, taken from actual operation in a large German power center, the author's method is fully explained. With slight changes the system may also be used for load distribution on generators in central stations.—*Elektrotechnische Zeitschrift*, Oct. 2, 1924.

Three-Phase Artificial Transmission Line.—S. BEKKU.—The design, construction and preliminary test of a high-voltage, three-phase artificial transmission line is described. The line consists of one hundred Π sections and can be used as two parallel lines of half length, the whole line working at 5,200 volts. Special endeavor was made to imitate the actual line in any unbalanced state. The self-inductance of the aërial line with earth return was studied. The whole line is equivalent to the three-phase aërial lines of two different line constants with the transient state as well as the steady state. The equivalent length of one of them is 515.1 km. and that of the other is 329.8 km.—*Research No. 127 of the Electrotechnical Laboratory, Tokyo, Japan.*

Units, Measurements and Instruments

Electric Testing of Mica.—F. GRUNEWALD.—Small plate electrodes are usually preferred for testing the dielectric strength of mica, but it is found that puncture occurs almost always near the edge of the electrodes, where the field is not uniform. Consequently the testing is carried on under oil. Owing to the great difference of the dielectric constants of mica (5 to 7) and that of oil (2.2), the results from such tests are neither correct nor logical. For example, various qualities of mica are obtainable, with greatly varying prices, yet the above tests do not show differences in the electric properties of these mica qualities which would warrant the higher price asked for some of them. The author has found that by expelling the air between plate electrodes and the tested mica sheet with aniline oil having a dielectric constant of 7 very marked differences can be found between various mica qualities. The author's experience has shown that the frequently observed red spots in mica are not detrimental electrically, but black, needle-shaped inclosures usually cause punctures.—*Elektrotechnische Zeitschrift*, Oct. 9, 1924.

Electrical Stethoscope.—H. A. FREDERICK and H. F. DODGE.—A summary of the applications and limitations of a new form of electrical stethoscope is given. This instrument, known as a "stethophone," consists of an electromagnetic transmitter, a three-stage amplifier with a potentiometer control, a selected group of electric filters and a multiplicity of output receivers for observers. Sounds that are inaudible in the ordinary stethoscope can be heard very distinctly with the new instrument.—*Bell System Technical Journal*, October, 1924.

Illumination

Headlight Regulations for Automobiles.—C. H. SHARP.—This is a report of the International Commission on Illumination presented before the convention in Geneva. The report is prepared on the basis of correspondence

which has been received from the various members of the committee. This correspondence has been of a very explicit character, and it enables the international situation with regard to headlighting of motor vehicles to be fairly well depicted. As a step toward agreeing on certain principles on which automobile headlighting and regulation should be based a set of principles has been formed. In an appendix the standard specifications for headlight control and the reasons for their adoption are given.—*Transactions of the I. E. S.*, October, 1924.

Passage of Light Transparent Plates. A. SCHUSTER.—In explaining the optical effects observed under suitable conditions in light that has passed through transparent plates it is the present practice to select certain groups of rays and to apply the principle of interference. The author substitutes a more rational procedure which discards the conception of rays and seeks guidance by following the wave fronts. The author claims that this method is more general and more effective.—*Philosophical Magazine (England)*. October, 1924.

Motors and Control

Forty Years' Development in Ice and Refrigerating Plants.—H. P. HILL.—The early history of refrigeration is recounted, with a description of the early types of machines. The recent progress in this field is described, including mention of the high-speed compressor, synchronous motor and oil-engine drive and the new shell-and-tube condenser. A description of an automatic starting system for synchronous motors, results obtained with different types of cans in ice making and some interesting experiments with supercooled water are other points considered by the author.—*National Engineer*, October, 1924.

Operation of Three-Phase Induction Motors Under Abnormal Supply Conditions.—D. D. EWING and C. F. BOWMAN.—The results of tests in which three-phase induction motors were operated under conditions differing from those for which the motors were designed are described. The test conditions used were those which frequently occur in actual motor operation.—*Circular No. 4, Engineering Department, Purdue University.*

Heat Applications and Material Handling

Application of Welding in the Structural Field.—The possibilities of welding and cutting as used in the fabrication of buildings and cranes were described in several papers at the annual convention of the American Welding Society, these papers being given in this issue. Important facts, figures and test data are presented. Among the papers are "Electric Arc Welding as a Method of Fabricating Large Structures," "Uses of Spot Welding in the Structural Field," "Arc-Welded Steel Building" and "Loosening of Rivets."—*Journal of the American Welding Society*, October, 1924.

Applications of Welding in Modern Power Plants.—H. A. WOODWORTH.—The different methods of welding and their applications in practice, with particular reference to their use in power plants, are described. Welded joints in many cases have a number of advantages over the flanged or screwed joint and over joints where a number of fittings are required. The paper tells how to produce a good welded joint by the oxyacetylene process and the factors to be considered, dealing with economies of welding and costs of different classes of work.—*National Engineer*, November, 1924.

Electrophysics, Electrochemistry and Batteries

Measurement of Hydrogen-Ion Centration with Glass Electrodes.—W. E. L. BROWN.—When two watery solutions are separated by a thin membrane of a suitable glass, a potential difference is set up between them which depends on their hydrogen ion concentrations. Glass electrodes made on this principle can be used to measure hydrogen-ion concentrations when the ordinary hydrogen electrode is useless on account of the presence of oxygen, etc. Special precautions are necessary in measuring the electromotive force on account of the high resistance of the electrode.—*Journal of Scientific Instruments (England)*, October, 1924.

Electrolysis of Hypochlorite Solution.—F. FOERSTER.—A very careful survey of the subject is presented, and it is shown that it is simply the potential at which the anions of the hypochalogenites are acted upon by current as compared with the discharge potentials of the corresponding halogen ions which determines the course of the electrolysis of alkali halogenides, and that all the details and apparent peculiarities in the phenomena attending these electrolytic processes may be investigated and satisfactorily explained with the aid of these potentials.—*Paper presented before the American Electrochemical Society*, Detroit, Oct. 2-4, 1924.

Traction

Electrification of Austrian Federal Railways.—J. A. G. PENNINGTON.—In the first installment of this article, published in the September 27 issue, the author discussed the operating characteristics and traffic density and the conditions which necessitate a change in motive power. In this concluding section he describes the hydro-electric plants, the scheme of transmission and distribution and the motive power.—*Railway Review*, Oct. 4, 1924.

Recent Developments in Electric Locomotives.—This is a summary of the discussion of papers by N. W. Storer and A. H. Armstrong published in *Mechanical Engineering* for September and October. Among other items the higher initial cost of electric as against steam locomotives is brought out—$5,145 against $2,132 per 1,000 lb. tractive effort in 1924, but with longer life. The first thirty-five New York Central electric locomotives, in passenger switching service for seventeen years, are about to be generally overhauled at an estimated average cost of $12,000, so that their total useful life may be thirty-five to forty years. It is the practice to send steam locomotives to the shop every five years.—*Mechanical Engineering*, November, 1924.

Telegraphy, Telephony, Radio and Signals

Transmission Characteristics of Electric Wave Filters.—O. J. ZOBEL.—Methods of calculation hitherto employed to determine the characteristics for composite wave filters have been long and tedious. The author gives a method for such determinations which greatly simplifies and shortens the calculations by the introduction of a system of charts. A detailed illustration of the use of this chart calculation method is given, and the transmission losses so obtained agree with those obtained by direct computation.—*Bell System Technical Journal*, October, 1924.

Transmission Characteristics of Coil-Loaded Telephone Cables.—K. OGAWA.—Transmission characteristics of coil-loaded telephone cables are discussed in a most exact way. The approximately equivalent circuit of the coil-loaded cable is derived, and it is shown that the assumption that the capacity between two consecutive loading coils is concentrated at the middle point of the cable leads sometimes to results containing errors. The attenuation constant of the loaded cable within the range of frequencies lower than the cut-off frequency is accompanied with considerable error if computed on the above assertion. A numerical example is given to illustrate these errors.—*Research No. 145 of the Electrotechnical Laboratory, Tokyo, Japan.*

Miscellaneous

Electricity in the Region of London. D. HEINEMAN.—This article contains a considerable amount of statistical information on investment, plant capacity, fuel economy, yearly output, recent growth, rates and population served for large communities in other parts of the world, with which the author contrasts corresponding figures for London. He finds a reason for the lower energy consumption per capita and the higher unit cost in London in the multiplicity of small generating stations, with the attendant wasteful use of capital and fuel, and urges the immediate adoption of a program of centralization of power supply together with systematic electrification of suburban railway lines. The annual production of electric energy per inhabitant of various countries in kilowatt-hours is: Switzerland, 700; Canada, 612; Norway, 493; United States, 472; Sweden, 364; France, 147, and the United Kingdom, 139. London and its surroundings are served by seventy-seven power stations, with about fifty distributing networks of two dozen different voltages and half a dozen different frequencies, often intertwined but despite this unable to render mutual assistance. The investment is so high and the load factor so low in London that the returns to capital are rather low. Bearing on railway electrification, various data are given regarding traffic and estimates made as to future growth.—*World Power (London)*, September, 1924.

News of the Industry

N. E. L. A. Convention

San Francisco Is Finally Chosen for the Forty-eighth Meeting on June 15-19

FRANKLIN T. GRIFFITH of Portland, Ore., president of the National Electric Light Association, has just announced that next year's convention of that body will be held at San Francisco, owing to the inadequacy of hotel accommodations in Portland. The date of the 1925 convention had previously been fixed for the week beginning Monday, June 15.

Although San Francisco, speaking through its Mayor, its Chamber of Commerce and other civic organizations, had expressed its desire to have the national association meet there next year, President Griffith naturally was partial to his home city of Portland, and he chose San Francisco reluctantly and only after numerous canvasses made by the Portland Chamber of Commerce and by members of the headquarters staff had proved that Portland's hotels would be inadequate for so large a convention, particularly during the tourist season.

Public utility officials in San Francisco are highly elated over the decision and have already made plans to entertain the delegates, besides obtaining assurances from the Hotel Men's Association of the city that excellent hotel accommodations and first-class service will be available during the convention.

At association headquarters in New York it was said that a committee on transportation will soon be announced so as to give ample time for perfecting details regarding such special trains and itineraries as may be decided on. In all likelihood a number of special trains and tours will be provided as on previous occasions when the conventions were held on the Pacific Coast.

St. Joseph, Mo., Defeats the Street-Lighting Bond Issue

A three-hundred-thousand-dollar bond issue for the reconstruction of the municipal street-lighting plant, requiring a two-thirds majority, has been defeated at St. Joseph, Mo., by 7,700 votes against to 3,500 for. This probably ends efforts to continue municipal ownership in St. Joseph. An offer to sell energy wholesale to the city on a twenty-year contract with Henry L. Doherty personally will be voted on December 16, as will also a contract with the St. Joseph Railway, Light, Heat & Power Company to build a street-lighting system doubling the number of lamps, discarding the magnetite-arc units and substituting "Mazdas." The contract for energy is to be made with Mr. Doherty personally at the request of the company in order to remove rate revision from the jurisdiction of the Missouri Public Service Commission. In a publicity campaign launched by the company under the direction of Glen Marston employees have volunteered their aid to S. B. Irelan, manager of the company.

Supreme Court Postpones Chicago Diversion Case

The argument before the Supreme Court of the United States on the appeal brought by the Sanitary District of Chicago to have set aside the decision of lower federal courts requiring it to reduce the quantity of water withdrawn from Lake Michigan (known as the Chicago diversion case), which was to have taken place last week, has been postponed until December 1. This action was taken at the request of the Solicitor General of the United States.

A meeting of the international engineering board, composed of technical representatives of Canada and the United States, is about to be called, in accordance with a Canadian suggestion. It is assumed that the principal topic of discussion will be the matter of diversion of Great Lakes waters. As an offset to the situation at Chicago in its international aspect, there is the matter of unequal diversion by Canada at Niagara Falls, where the Dominion takes 36,000 second-feet against 20,000 second-feet taken by the United States, and also the diversion of 1,000 second-feet by Canada at the Welland Canal, in addition to several diversions at points along the St. Lawrence River. In connection with the diversion at the Welland Canal it is understood that Canada is considering the abandonment of the use of that water, or at least of deducting it from its 36,000 ft.

In the meantime members of Congress from Chicago are preparing to push legislation authorizing the diversion of 10,000 second-feet. It is almost certain that Congress will not pass this bill, but the effort is likely to result in authorization for a more comprehensive study than has been made heretofore. The Corps of Engineers of the army in its previous studies of this matter has labored under the difficulty of insufficient funds. Specific authorization for a new report would remove that difficulty.

Washington Discusses Plans for Muscle Shoals

Secretary of War Weeks is seeking a legal decision on his authority to contract for the temporary sale of Muscle Shoals power should Congress fail to dispose of the government plants before the Wilson Dam is finished. Senator Ladd of North Dakota, last session a leading Ford man, has declared himself in favor of empowering the President to arrange for the disposal or operation of the plants. Other Ford supporters in the Senate are seeking a compromise plan of government operation.

Illinois Central Contract

Commonwealth Edison Will Supply 30,000 Hp. for Electrification of Suburban Service

A TEN-YEAR contract for the purchase of 30,000 hp. of electrical energy from the Commonwealth Edison Company, Chicago, for electrifying the Chicago terminal dstrict was recently signed by the Illinois Central Railroad. This contract provides for an optional extension to 1947. The Edison company is to start supplying the energy at the beginning of the summer of 1926 and is now commencing the building of seven substations which it will maintain and operate along the Illinois Central right-of-way. The agreement makes it certain that the Illinois Central electrification can be constantly kept in step, at least possible cost to the railroad company, with developments in the economical production and utilization of electrical energy. Under its terms, electrilcation of the company's right-of-way will extend as far as Matteson on the main line and include the South Chicago and Blue Island branches. Freight service will next be electrified, thus causing the elimination of all steam locomotives from the lake front. The agreement also provides for the installation in the substations of automatic-control signal equipment and the lighting of all suburban stations and the new central terminal station. The Markham yards, a large freight center, will also be electrified.

Mr. Loyd's Statement

E. W. Loyd, general contract agent for the Commonwealth Edison Company, has made the following statement: "Procedure for the building of seven substations along the Illinois Central right-of-way will begin at once, to be located at distances varying from five to seven miles. The energy will be furnished from the company's main generating plants through underground circuits. While the amount of energy called for at the beginning will be 30,000 hp., the completed electrification program will require 50,000 hp. The substations will distribute 1,500-volt direct current to the railway's overhead trolley system. The high-tension supply will be furnished through 60-cycle, 12,000-volt feeders."

The acquisition of this business by the Commonwealth Edison Company means a further step in superpower development in the Chicago area. It means also a marked advance toward the electrification of all railroad terminals. "This is a natural thing to happen, particularly in view of what has gone on before in the development of large concentrated generating facilities within the Chicago district," declared Samuel Insull, president of the Commonwealth Edison Company, in commenting upon the contract.

River Pact Thought Dead

Federal Board Likely to Grant Rights on Colorado if Arizona Is Still Obdurate

WITH the Colorado River compact as the chief issue in the state campaign, Arizona re-elected Governor Hunt. This is believed at Washington to end all hope of ratifying the interstate treaty. While final action must be taken by the Arizona Legislature, it is anticipated that that body will interpret the election as a mandate from the people, which will preclude the ratification of the compact.

It is probable that the Federal Power Commission will withhold action on Colorado River projects until it has been established definitely that the treaty will not be ratified. The Legislature will be in session from January to April. Once it is established that Arizona will not ratify the treaty, it is expected that the commission will proceed with the granting of rights.

A new complication exists, however, in the Girand application for rights on the Colorado at Diamond Creek. Arizona has taken a position contrary to that of any other Western state in contending that Mr. Girand has lost his state rights by failure to continue construction work, regardless of the fact that he was forced to discontinue work by a federal injunction. While the Federal Power Commission is committed, morally at least, to grant the Girand license, it is entirely possible that its issuance may be delayed further, pending the outcome of litigation as to the validity of his state rights.

Developments may come rapidly on other phases of the Colorado River problem. Dr. Elwood Mead, the new Commissioner of Reclamation, has announced that he is not wedded to the Boulder Canyon dam proposal, and the speedy demise of the Swing-Johnson bill is looked for. A report has reached Washington to the effect that Los Angeles is planning to apply for rights in Boulder Canyon with the idea of financing the development itself.

While these various matters are being determined, further engineering studies on the lower Colorado are urged. These studies could establish more definitely than is known now the character of projects which fit best into the full development of the river. In that connection it is also being urged earnestly that immediate steps be taken to negotiate a treaty with Mexico to determine the rights of each country in connection with the Colorado and Rio Grande. If anything is done before that treaty is ratified to increase the low-water flow through the Mexican section of the river, the right of the land owners in Mexico will have been established, and it may be taken for granted that none of that water will be withdrawn by treaty once it is put to use.

Niagara Falls Power Company Seeks Rights in Gorge

The Niagara Falls Power Company has asked the New York Public Service Commission to consent to its purchase of all or any part, not less than a majority, of the capital stock of the Niagara Gorge Railroad Company. The petition sets forth that the principal reason why the company desires to purchase the stock is its value in connection with any future hydraulic power development on the American side of the Niagara River in the lower gorge of the river. According to the petition, no stock in the railroad company is now held by the Niagara Falls Power Company, but a considerable portion of the stock was purchased recently by individuals associated with the petitioner.

One paragraph of the petition says that the Niagara Gorge Railroad Company is the owner of all the stock of the Niagara Gorge Power Company, a corporation organized in or about the year 1905 for the purpose of developing hydro-electric power from the waters of the Niagara River in the lower gorge. The Niagara Gorge Railroad Company has been operated as a scenic road, carrying passengers along the gorge of the Niagara River and from Niagara Falls to Lewiston.

Sale of Holyoke Street Railway Plant Ratified

Stockholders of the Holyoke Street Railway Company, meeting in Holyoke, Mass., on November 18, ratified the plan of sale of the company's power plant in Holyoke to the Turners Falls Power & Electric Company, at a price of $400,000, together with a twenty-year contract for purchase of electrical energy by the street railway company from the Turners Falls Company, beginning January 1, 1926. Action was virtually unanimous, only about 600 votes being opposed as against about 10,000 in favor. Action to the same end was taken by the street-railway directors three weeks before.

American Power & Light Now Acquires Phoenix Utility

The American Power & Light Company, which, as reported last week, has just bought additional properties in Florida, now makes the further announcement that it has acquired control of the Central Arizona Light & Power Company, serving with electric power and light and gas Phoenix, Ariz., and adjoining territory. The Florida properties now controlled, all of which have been acquired during the present year, are in thirty cities and towns and have present annual gross earnings of approximately $5,500,000. During the present year the American Power & Light Company has also largely extended its interests in Minnesota and Texas through the acquisition of additional properties by the Minnesota Power & Light Company and the Texas Power & Light Company and the Texas Public Utilities Company.

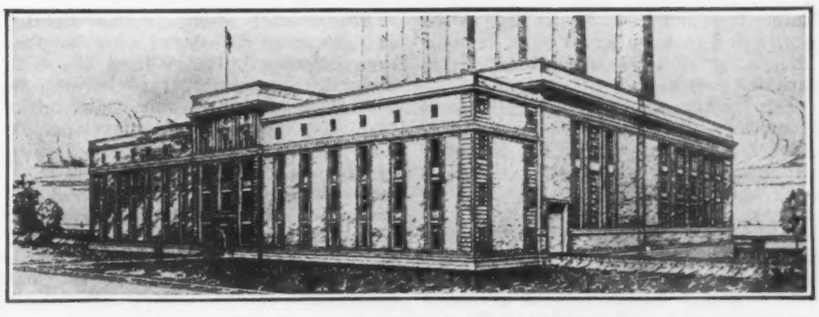
The properties in which the American Power & Light Company is now interested serve in all 440 communities in Oregon, Washington, Idaho, Kansas, Nebraska, Iowa, Minnesota, Wisconsin, Arizona, Texas and Florida. Among the most important cities served by the operating companies are Portland, Walla Walla, Lewiston, Wichita, Omaha, Council Bluffs, Duluth, Superior, Phoenix, Fort Worth, El Paso, Galveston, Waco, Miami, Daytona and St. Augustine. The total population served is estimated at 2,300,000. The operating companies serve a total of more than 460,000 customers, of whom about 300,000 are served with electric power and light. The present total annual gross earnings of the operating companies reach an aggregate in excess of $40,000,000.

Cleveland to Have New 300,000-Kw. Power Station

ANNOUNCEMENT was made last Saturday by F. L. Dame, president of the North American Company, that its subsidiary, the Cleveland Electric Illuminating Company, will soon begin the erection of a 300,000-kw. steam station at Avon, on Lake Erie, just west of Cleveland. The station will eventually cost about $30,000,000. It will tie in with the company's Lake Shore station in Cleveland, which is said to be the largest steam-electric power station anywhere under one roof. When the new station is finished, the combined output of the two plants will be 600,000 kw.

The initial installation at Avon will be 67,500 kw., in three units of 22,500 kw. each. Construction will be started as soon as weather conditions permit. The plant will be an important feeder to the extensively interconnected lines of the Middle West. The Cleveland company's system is now connected with the systems of the Northern Ohio Traction & Light Company, the Ohio Public Service Company and the Ohio Power Company, covering the industrial region of northern and eastern Ohio.

The Avon station will be equipped to burn pulverized fuel, as are the Lake Shore station and two other large plants of North American Company subsidiaries—the Lakeside plant at Milwaukee and the Cahokia plant opposite St. Louis.



ARCHITECT'S DRAWING OF PROJECTED CLEVELAND POWER STATION

League Council Organizes

T. C. Russell Elected President — Recommendations to Society for Electrical Development

THE League Council, elected in September at the Electrical League conference on Association Island to represent the local electrical leagues of the United States and Canada and to act in an advisory capacity to the Society for Electrical Development in its work of league service, held its first on the functions of league headquarters of the Electrical League of Cleveland on Monday and Tuesday. This meeting was for the purpose of effecting organization, reviewing the present needs of the league service now being provided by the Society for Electrical Development, at the request of the past league conferences, and to develop a working arrangement with the society to carry on the functions of league headquarters and league service under the authority and guidance of the League Council.

The council elected as its chairman Thomas C. Russell, president Russell Electric Company, Chicago, and director of the Electric Club of Chicago, and as its vice-chairman Earl E. Whitehorne, commercial editor of the ELECTRICAL WORLD and a director of the New York Electrical League.

The following were elected to serve with them as an executive committee to take the active responsibility: F. B. Adam, president Frank Adam Electric Company, St. Louis, and president St. Louis Electrical Board of Trade; E. M. Ashworth, manager Toronto Hydro-Electric System and president Electric Service League of Toronto; H. A. Brooks, commercial manager Potomac Electric Power Company and president Electric League of Washington, D. C.; M. A. Curran, of the Western Electric Company, New York, and former president of the Cincinnati Electric Club, and J. E. North, commercial agent Cleveland Electric Illuminating Company and president Electrical League of Cleveland.

The council spent considerable time in discussing the problem of financing league service and development, the question naturally dividing itself into two considerations—first, the national work that must be done to promote league development and, second, the local business development work performed by leagues. The national work at the present time is being financed by representatives of all groups of the industry through the Society for Electrical Development, since about one-third of the budget of the society is at present expended in league development and service. The local work is financed principally by funds raised locally and in some small part, in some cities, through subscriptions from national sources.

The society also contributes to local promotion through its services rendered to leagues. There is no standard practice in the financing of league work, and the council voted to make a study of the conditions with a view to developing a standard of practice for the guidance of leagues and those who contribute to their support.

The council commended the action of the directors of the Society for Electrical Development in applying one-third of the budget of the society to league service, and expressed the opinion that the society is justified in seeking increased support from national sources to further this work of broadening and extending the league movement. The council also requested the society to undertake:

1. To prepare a report of its activities in league promotion for the year 1924 and a list of its services now available, for the information of the league.

2. To investigate the possibilities for league organization in all cities of the United States and Canada of over 100,000 population and to promote the development of leagues in them as rapidly as practicable.

3. To prepare a manual on league organization, subject to the approval of the executive committee of the council.

4. To appoint a member of its staff to serve as secretary of the council and to provide the necessary headquarters equipment. Kenneth McIntyre, who has had wide experience in field work with leagues, has been designated for this appointment.

The League Council indorsed the "Red Seal" plan for the promotion of adequate wiring and recommended its adoption by the leagues. It also recommended that the name "Electrical League of [any city]" be adopted as a standard for new leagues so as to lend itself more effectively to public acceptance and to tie in with co-operative national advertising.

Electrical Supply Jobbers Meet at Cleveland

The regular winter meeting of the Electrical Supply Jobbers' Association was held this week at the Hotel Cleveland, Cleveland, committee meetings and executive sessions occupying Monday, Tuesday and Wednesday and general meetings continuing through Thursday and Friday.

General Guy E. Tripp, chairman board of directors of the Westinghouse Electric & Manufacturing Company, spoke on Thursday on the distribution problems of the manufacturers and their bearing upon wholesale distribution. A. Penn Denton, Kansas City, chairman of the Association of Electragists' National Electrical Code committee, spoke on the enforcement of the National Electrical Code and the progress that is being achieved toward its uniform interpretation through the work of the local code committees which through the efforts of his committee have now been established in more than one hundred cities.

At the later session Powell Crosley, Jr., president Crosley Radio Corporation, discussed "Radio from the Commercial Standpoint," reviewing the conditions of the present radio market and expected future developments. Earl E. Whitehorne, commercial editor of the ELECTRICAL WORLD, spoke on local league organization and coordination and pictured the present trends and possibilities for the extension of this growing movement in the co-operative development of the local market for electric wiring, service and appliances.

Commercial N. E. L. A. Meetings at San Rafael, Cal.

The annual Western meeting of the Commercial National Section committees of the National Electric Light Association opened at San Rafael, Cal., on Wednesday, November 18, for a three-day session with a total registration up to Wednesday night of 110. Chairman W. R. Putnam presided. The lighting committee discussed whether or not the industry should try to capitalize in a commercial way on the home-lighting contest. It was the consensus of opinion that this educational work should be followed by properly directed sales campaigns. It was the unanimous opinion of the committee that the lighting educational course which has been conducted during the past few years be continued. The suggestion was made that a lighting and industrial-heating as well as a transportation school be held in San Francisco just prior to the national convention there next June. At the meeting of the Power Bureau a motion was passed asking the executive committee of the Commercial Section to approve an industrial heating school.

The appliance committee will devote its efforts this year largely to producing and assembling appliance sales data. Information will be sought on definite selling methods which outline point by point the methods used in successful campaigns. The Appliance Bureau of the Pacific Coast Electrical Association has a program of campaigns.

A long discussion took place on the question of central-station merchandising. It was the general opinion that a sound policy of central-station merchandising is not only necessary to bring about the desired volume of this class of business, but that the sales organization is the power company's most important point of contact with its customers and the public.

Centenary of Carnot's Thermodynamic Announcement

The hundredth anniversary of the announcement by the French physicist and engineer Nicholas Leonard Sadi Carnot of the principle of thermodynamics, later known as the "second law of thermodynamics," and the Carnot cycle will be celebrated by American engineering, physical and chemical societies and educational institutions of the New York metropolitan district on Thursday, December 4, at the Engineering Societies Building, under the auspices of the Engineering Foundation. Members of the A. I. E. E. will have a prominent part in the program, Dr. M. I. Pupin giving an address on "Carnot's Principle" and Dr. W. L. R. Emmet one on "The Application of Carnot's Principle in Engineering." Alfred D. Flinn, the director of the Engineering Foundation, has had general charge of the celebration, the committee on arrangements comprising George H. Pegram, A. S. C. E.; W. L. Saunders, A. I. M. E.; Joseph W. Roe, A. S. M. E.; L. W. W. Morrow, A. I. E. E., and Dean George B. Pegram, Prof. Walter I. Slichter and Prof. Walter Rautenstrauch of Columbia University. President-elect William F. Durand of the A. S. M. E. will preside.

Public Relations Theme of West Virginia Utility Men

Publicity and public relations were prominent topics at the seventh annual convention of the West Virginia Public Utilities Association, held at Charleston, November 14 and 15.

D. I. McCahill, general counsel for the West Penn Power Company, Pittsburgh, said that unfair regulation of public utility companies was also unfair to the public, which would suffer because of the lack of investment and hence the curtailment of service. He championed the publicity bureau to bring the facts home to consumers.

W. M. Stearns, General Electric Company, Schenectady, N. Y., said that the investments of light and power companies will soon be second to those of no other industry. The cost of electricity, he pointed out, had gone down as the investments had increased. He discussed the customer-ownership movement and gave a history of electrical development.

J. W. Weir, field secretary of the West Virginia Publishers' Association, said that public utilities must advertise to sell their service and told of companies rendering excellent service which went unappreciated for lack of information.

Other addresses were made by John B. Garden, manager of the Wheeling Electric Company; R. P. Stevens, president Republic Railway & Light Company, Jersey City, N. J.; D. L. Gaskill, president Greenville (Ohio) Electric Light & Power Company; Mayor Wertz of Charleston, who praised utilities for adopting the "human idea in business"; N. M. Argabrite, American Gas & Electric Company, New York, who discussed "Superpower Systems"; Senator F. W. King, president of the Virginia Public Utilities Association, and Secretary A. Bliss McCrum of the association. A successful banquet was held at the Kanawha Hotel on Friday night.

Officers elected were: President, Mentor Hetzer, Moundsville Water Company; first vice-president, W. R. Power, Consolidated Power & Light Company, Huntington; second vice-president, J. E. Harsh, Virginia Power Company, Charleston; third vice-president, J. D. Whittemore, Monongahela-West Penn Public Service Corporation, Fairmont; secretary, A. Bliss McCrum, Charleston; treasurer, A. M. Hill, Charleston.

Lighting Campaign Subscribers Reach 142

Nearly all of the local home-lighting contests are closed. The remaining ones must close by December 1, and the winning primers and essays must be in the hands of the committee not later than December 15. A meeting of the seven international judges has been called for December 29 and 30, and it is planned to determine on the latter day the winners of the fifteen-thousand-dollar home, the ten scholarships and the thousand medals. The names of the winners will be released to the press as soon after this date as possible.

Since the last report to the ELECTRICAL WORLD concerning subscribers, the following have contributed to the fund of the committee, making a total of 142 subscribers:

American Electrical Works, Phillipsdale, R. I.
Appleton Electric Company, Chicago.
Artistic Lighting Fixture Corporation, New York.
Cutler-Hammer Manufacturing Company, Milwaukee.
Gruber Brothers, New York.
Hemingray Glass Company, Muncie, Ind.
Indiana Steel & Wire Company, Muncie, Ind.
Landers, Frary & Clark, New Britain, Conn.
Manhattan Electrical Supply Company, New York.
Owen Walsh Company, New York.
Peerless Light Company, New York.
Pittsburgh Lamp, Brass & Glass Company, Pittsburgh.
Henry D. Sears, Boston.
Square D Company, Detroit.
Star Porcelain Company, Trenton, N. J.
R. Thomas & Sons Company, East Liverpool, Ohio.
Tiffany Studios, New York.
Triumph Lamp Works, Indianapolis.
Wirt Company, Philadelphia.

Aylesworth Interests National Commissioners at Phoenix

The annual convention of the National Association of Railway and Utilities Commissioners was held at Phoenix, Ariz., November 11 to 14 inclusive. Although Phoenix is one of the most distant points to which the association has gone for its annual meeting, it was one of the best attended and enthusiastic meetings held in years. About thirty-five states were represented, and the sessions were continuous from Tuesday morning until late Friday evening.

The address by M. H. Aylesworth, executive manager of the N. E. L. A., in which he briefly outlined the progress being made in interconnection and superpower systems throughout the country, picturing what this means to the economic future of the nation, aroused great interest and was followed by general discussion. It was decided that a special day would be set apart at the next annual meeting of the association for a complete discussion of the subject in which it would be presented in all its aspects by those most familiar with what is taking place.

Mr. Aylesworth spoke also of the necessity of the state commissions' retaining and exercising their jurisdiction over electric utilities and the way in which electric development would be hampered in case this jurisdiction should be materially curtailed by the exercise of federal authority through a bureau at Washington. He dwelt at length upon the necessity for co-operation between the various commissions in the exercise of their authority and the advantages which would come from uniformity in state regulatory practice.

The standing committee on government ownership made its seventh annual report to the convention and reiterated the advocacy of private ownership so strongly expressed by former committees. This year's report is one of the most exhaustive yet made.

H. C. Abell, recently elected president of the American Gas Association, addressed the association on the general question of the relations between the public utility commissioners and the regulated utilities. Carl D. Jackson, counsel for the National Electric Light Association; J. N. Shannahan, president of the American Electric Railway Association, and William N. Sproule, president of the Southern Pacific Railroad Company, also made addresses. As reported last week, William D. B. Ainey, president of the Pennsylvania Public Service Commission, was elected president of the national association.

Brooklyn Edison Takes Over Flatbush Business

Final authorization to the Brooklyn Edison Company to take over the electrical business of the Flatbush Gas Company has been granted by the New York Public Service Commission, after a delay of a year attributed to procrastination by the city authorities. This will mean a 20 per cent reduction in rates to forty thousand customers in the Flatbush section, amounting, President M. S. Sloan estimates, to $300,000 annually.

"The Flatbush territory," Mr. Sloan continued, "is surrounded by substations of the Brooklyn Edison Company, and one of the first things that will be done in this new territory is to apply to it the three-phase, four-wire system of distribution that is being adopted throughout Brooklyn.

"Our program of construction for the new territory involves, in addition to changing the distribution system and building a new 40,000-hp. substation, placing all Flatbush street lights on the same physical basis as in the rest of Brooklyn. It will take approximately a year of rush work to carry this program through, although it is expected that temporary arrangements can be made whereby the present steam generating station can be shut down early in April, throwing all of the Flatbush business on to our adjacent substations.

"The new substation and its equipment will cost over $500,000. The changes in the distribution system will involve an expenditure of approximately the same amount."

Empire State Association to Discuss Electric Progress

The annual fall meeting of the Electric Section of the Empire State Gas and Electric Association will be held at Syracuse on December 4 and 5. The various committees have done a great deal of work this year, some of it in conjunction with the Pennsylvania Electric Association, and their reports contain many matters of great interest to engineers and operating men. The tentative program is as follows:

THURSDAY, DECEMBER 4

Morning.—Report of overhead distribution committee, J. O. Montignani; "Progress in Farm Electrification in New York," rural lines committee; "Public Utilities and Their Public Relations," New York State Committee on Public Utility Information.

Afternoon.—Report of underground distribution committee, R. A. Paine; report of transmission lines committee, C. A. Bacon; technical questions relating to interconnection.

FRIDAY, DECEMBER 5

Morning.—Report of water-power committee, F. J. Howes; address on water-power situation by a prominent engineer; report of operation committee, A. C. Jordan; report of electrical apparatus committee, R. F. Burnett.

Power Demands Exceed Hydro Resources

Federal Commission Urges Need of Greater Water-Power Development—Co-ordination of Power and Navigation—Fish Problem—Personnel and Funds Still Needed

THE fourth annual report of the Federal Power Commission has just been released. In it the commission renews the recommendation made in its third annual report that suitable amendment be made to the federal water-power act to permit the employment of its own personnel in order to enable the commission adequately to carry out the duties and responsibilities imposed by the terms of the act. It says:

"Notwithstanding the volume of applications presented in the first three years of the administration of the federal water-power act, eighty-seven more, involving an estimated installation of 3,325,000 hp., were filed during the fiscal year 1924, and fifty-seven permits and licenses were issued with an estimated installation, if built, of 1,160,000 hp. There are 204 permits and licenses outstanding, aggregating 7,850,000 hp. Sixty-seven projects with a prospective installation of 2,782,000 hp. have been completed or are under construction, of which eighteen with a combined installation of 259,000 hp. were started during the year. A constantly increasing part of the work of the commission consists in the administrative duties with respect to projects already under permit or license. Preliminary permits are being changed into licenses, and licensed projects are being constructed, requiring examination of plans, inspection of construction and audit of construction accounts. . . . With sixty-seven projects constructed or under construction, involving several hundred million dollars and in some instances requiring extensive valuation, and with only two accountants to perform the work, it is manifestly impossible to secure satisfactory results."

The commission renews the recommendation that legislation be enacted which will give it authority to use the charges now collected for defraying costs of administration in preparing comprehensive plans, first, for co-ordination of effort in water-power development and improvement for navigation purposes of the inland waterways of the United States, and, second, for stream development in order to secure the greatest practicable utilization of the water power of all streams. It is estimated that there are 4,300 miles suitable for power development and for a form of navigation appropriate to such development, and that these 4,300 miles have 10,000,000 potential water horsepower.

WATER POWER AND NAVIGATION

As to the need of comprehensive plans for co-ordination of water-power development and improvement of navigation, the report says:

"The two chief ways in which water-power development and navigation may be correlated are, first, by affording opportunity for slack-water navigation in the pools behind dams erected primarily for power development, and, second, by increasing the low-water flow and reducing the liability of flood damage through the utilization of storage reservoirs, also erected primarily for purposes of power development. In the first case the major item of expense in the navigation improvement—the dam—will in all cases have been provided without expense to the United States. If locks are not needed at the time of original construction, they can be supplied by the United States when needed at a cost much less than an original navigation improvement. In the second case the stored water available for increasing low flow and the storage capacity available for reducing flood flow will not be so great as if provided for these purposes only, but the benefit which navigation does receive will be wholly without expense.

"In its administration of the federal water-power act the commission has taken advantage of both of these means of aiding navigation. It has issued forty-five licenses and permits for power development on streams classed as 'navigable waters' under the act, seven of which are at government dams, and ten licenses and permits for developments in non-navigable tributaries of navigable streams, where construction would affect the interests of interstate or foreign commerce by modifying the river discharge because of the storage created. . . .

"In addition to the great desirability of co-ordinating navigation and power development on all streams where both uses can be had," the report continues, "is the necessity of securing the greatest practicable utilization of the water power of all our streams. We have no national surplus of water-power resources. Our best estimates indicate that we have a total of 55,000,000 hp. of developed and undeveloped water power available for 50 per cent of the time. The combined installation in central electric stations, electric railways and industries in the United States in 1924 is estimated at 56,000,000 hp., with several millions more employed in railroad transportation. Our present power demands, therefore, exceed our total water-power resources, and we should not permit waste in their development. Furthermore, 72 per cent of our water-power resources are west of the Mississippi while 79 per cent of our power requirements are east of that river. In the eleven Northeastern States, where our greatest industrial concentration is found, our total water-power resources are less than one-third of the present power demands, exclusive of the railroads.

"It is universally recognized that the future of American industry and transportation is dependent upon the use of electrical energy and that in the production of such energy water power should be used to the full extent of its economic feasibility. If, therefore, we are to develop these powers to the fullest productivity, free of all avoidable waste, and are to secure at the same time the correlated use of the waters for navigation, irrigation and other beneficial purposes, we must change from the haphazard methods heretofore employed and proceed to prepare real plans of comprehensive stream development. . . .

"The commission has proceeded to the full extent of the means at its disposal. Through the agency of interdepartmental boards which it has formed it has made studies and published reports of the Columbia River in Washington and of the Deschutes River in Oregon. It has made similar studies of the Trinity and American and Stanislaus Rivers in California, the results of which will soon be published. It has co-operated with the Department of Agriculture in the preparation and publication of a report on the water powers of southeastern Alaska. These studies and reports are useful as far as they go, but adequate plans of river development require more intensive studies, actual surveys of sites and tentative location of dams and other structures. This is the plan Canada has followed."

WATER-POWER AND FISHERIES

The report then takes up the conflict between fishery and power interests, saying, among other things:

"Two questions are presented to the commission when applications are filed for dams in streams frequented by migratory fish: First, whether the erection of high dams is a necessary bar to the passage of the fish, and, second, to what extent, if any, the commission should assume the responsibility of deciding questions of local policy when state laws and state agencies for determining these policies already exist.

"From the beginning of its adminis-

WATER-POWER APPLICATIONS BY STATES TO JUNE 30, 1924

State	Number of Applications	Gross Horsepower* Primary	Estimated Installed Capacity
Alaska	26	151,111	198,005
Alabama	7	80,080	352,000
Arizona	17	6,348,300	9,934,500
Arkansas	4	106,500	191,200
California	100	2,224,098	4,257,194
Colorado	18	70,753	97,635
Connecticut	1	20,000	20,000
Dist. of Columbia	1	47,300	50,000
Florida	2	2,260	7,000
Georgia	1	28,000	80,000
Idaho	24	105,845	217,290
Illinois	2	42,350	55,500
Indiana	1	4,900	9,800
Kentucky	4	87,950	274,250
Louisiana	1	40,000	55,000
Maine	1	250,000	650,000
Maryland	1	53,500	360,000
Michigan	1	590	2,300
Minnesota	10	62,920	161,700
Missouri	4	49,000	165,000
Montana	12	295,400	515,110
Nevada	3	.....	.....
New Mexico	2	4,900	9,350
New York	9	3,296,125	3,972,830
North Carolina	4	90,690	217,800
Ohio	2	540	1,050
Oklahoma	1	2,880	11,000
Oregon	19	360,941	616,241
Pennsylvania	6	93,600	379,000
South Carolina	2	42,000	122,000
South Dakota	1	.....	.....
Tennessee	5	599,000	983,500
Utah	5	670,210	1,027,710
Virginia	1	.....	.....
Washington	16	1,050,880	1,840,550
West Virginia	4	233,200	840,000
Wisconsin	1	14,430	14,430
Wyoming	4	1,314	2,614

* No deductions made for conflicting applications.

tration the commission has followed the practice of working in close co-operation with those state authorities upon whom has been placed by law responsibility respecting power development within their states. It believes this course should continue to be followed unless some substantial rights of the United States as a whole are involved. In the only instance where acute controversy has developed between fishing and power interests on a stream the commission has issued preliminary permits corresponding to the rights previously issued by the authorities of the state. Such permits, however, do not permit construction and contain a provision that license shall not be issued unless adequate provisions are made for the maintenance of existing conditions of fish migration and fish culture upon the river."

Alluding to the experiments being made on the Columbia River, the report says:

"While definite conclusions cannot be stated, it seems probable that whether migratory fish will or will not pass over a dam is not so much a question of height of dam as of the character of the facilities provided; that is, a question of cost."

Standards Bureau Report

Its Electrical Investigations Include Survey of Street Lighting in Cities of 10,000 Up

SCIENTIFIC investigations and tests resulting in large savings to the government and to American industry through improvement in processes and the fixing of uniform standards are featured in the annual report of Director George K. Burgess of the Bureau of Standards, submitted to Secretary of Commerce Hoover and just released.

An important part of the bureau's work in electricity is concerned with fundamental investigations of electrical standards from which the working standards used by manufacturers of electrical apparatus are derived, and several fundamental investigations are in progress. A new determination of the ohm in absolute units, a determination of the ratio of the international to the absolute henry and the design and construction of an absolute electrometer for measurement of voltages up to 250,000 are well advanced.

Progress is reported in attaining accuracy of frequency standards for radio and in developing radio beacons. Electron tubes used in radio and methods of testing them have been standardized in co-operation with manufacturing interests and engineering societies interested. Promising experiments with electrified insecticide dust have been made. Wire rope has been tested by magnetic analysis in order to establish the relations between the magnetic properties of wires used in such rope and its deterioration. A study of the effect of mechanical stress on the magnetic properties of steel wire has been completed and is nearly ready for publication. An investigation of the effect of wear is nearly completed, and work is in progress on the effects of fatigue and corrosion. The design and construction of apparatus for field tests have been begun.

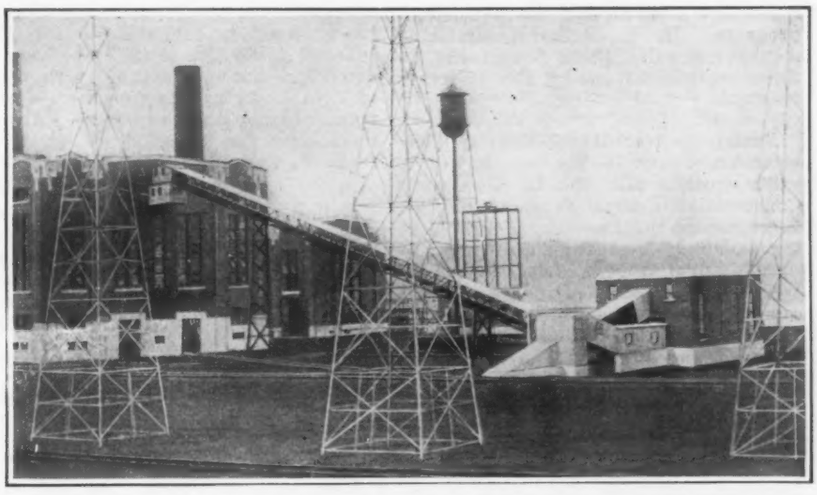
Other work performed by the electrical engineers in the Bureau of Standards in the year just past included a survey of the electric light and power requirements of such of the government's buildings as could be supplied readily from a central plant, progress in the revision of the National Electrical Safety Code and other safety codes in which electricity has a part, a survey of street-lighting practice in municipalities of 10,000 population and more, which is nearing completion, and an extended and continuing investigation (begun in 1922) to determine the causes and mechanism of the corrosive action of various kinds of soil on underground pipes. To further a co-operative investigation with a special committee of the American Society of Civil Engineers on impact in highway bridges, which has been carried on for some time, a twelve-element electric strain gage has been constructed under the bureau's supervision, and field tests are now in progress at Ames, Iowa.

Grand Tower Station in Operation

Central Illinois Public Service Company's New Power House Has Initial Rating of 40,000 Kw.—With Station at Muddy, It Serves Southern Counties

ABOUT twelve years ago the Central Illinois Public Service Company, a subsidiary of the Middle West Utilities Company, began the construction of a high-voltage transmission network for the purpose of serving the cities and mines in southern Illinois. A station at Muddy, Ill., north of Harrisburg, was the source of power. Although for ten years this station has been under almost continuous enlargement until it has at the present time 25,000 kw. capacity, it was soon apparent that it would not be able indefinitely to provide energy requirements for the territory served as there were limitations of available water supply. An ideal site was therefore chosen in the company's southern Illinois territory for a station capable of extraordinary expansion—Grand Tower, on the Mississippi River. Here there is an inexhaustible supply of condensing water, and the site is but 36 miles from West Frankfort, the center of the district's load, and is adjacent to the southern Illinois coal fields.

Eighteen months ago work was begun on the Grand Tower station, which is now complete. The first unit was put in operation on September 5 and the second unit on October 1. The plant capacity at this time is 40,000 kw. This gives to the southern Illinois field in the two stations at Muddy and Grand Tower a total capacity of 65,000 kw. Connecting these two stations is a 66,000-volt steel-tower, double-circuit transmission line with concrete tower bases. Lines extend from Muddy to the West Frankfort switching station, a distance of 24 miles, and from Grand Tower to West Frankfort, a distance of 36 miles. The West Frankfort switching station constitutes what might be called a base between the two generating stations. Here the voltage is reduced from 66,000 to 33,000. Transformer capacity of 50,000 kw. is provided. Along the 33,000-volt lines more than 100 high-tension substations reduce the voltage from 33,000 to 2,300 for mines and for the supply of distribution systems in many cities and towns.



NEW MISSISSIPPI RIVER POWER HOUSE OF CENTRAL ILLINOIS COMPANY AT GRAND TOWER

When the Central Illinois Public Service Company entered the southern Illinois field small isolated generating stations existed in Harrisburg, Marion, Herrin, Carterville, Carbondale, Johnson City and other communities. These systems were purchased and have been standardized and modern transmission lines have been constructed, so that the distribution of electrical power can be made from energy generated in one or two large plants. Exclusive of the new steel-tower lines connecting the Grand Tower and Muddy power stations, the company has since 1918 expended more than $9,000,000. It contemplates constructing within the next year a high-voltage transmission line from southern Illinois to serve the company's properties in central Illinois.

Briefer News

South Dakota Plant Sold.—The Mobridge Electric Company, operating in Mobridge, Glenham and Selby, S. D., has been purchased by D. R. and H. V. Croswell, operators. They plan several extensions of line and an increase in the plant at Mobridge.

Fairmont, Minn., Holds on to Its Municipal Plant.—The Fairmont (Minn.) City Council has voted to lay on the table indefinitely the proposal of the Interstate Power Company to buy the local municipal light plant at a price of $450,000 cash. Some of the members were, however, in favor of accepting the bid.

Georgia Electrical Association Meeting.—The Georgia Electrical Association will hold its semi-annual meeting on Wednesday, November 26, at the East Lake Country Club, Atlanta. It will follow a "radio and merchandising" program. H. T. Melhuish, assistant manager of sales, Radio Corporation of America, will be one of the principal speakers.

Racial Riot at Hydro-Electric Construction Camp. — The murder of a white workman in the L. E. Meyers Construction Company's camp on Dix River, where the Kentucky Hydro-Electric Company is erecting a dam, led to serious racial trouble early this month. White workers stormed the part of the camp occupied by negro employees and drove them out. One negro was wounded and nineteen beaten. State militiamen restored order.

Southern Sierras Completes Power Plant.—The Adams hydro-electric power plant of the Southern Sierras Power Company, Riverside, Cal., built in the Owens River gorge, was completed and placed on the line October 15, two weeks ahead of schedule. The plant has a capacity of 10,000 kva., which was utilized to good advantage during the final weeks of the power shortage in southern California.

Port of Kalama Plans Big Hydro-Plant.—The Port of Kalama, Wash., as a part of the general scheme of hydro-electric power development planned by it, has filed with the Supervisor of Hydraulics application for a permit to establish the Lake Merrill reservoir, to supply a large hydro-electric plant at an estimated cost of $1,100,000.

Selinsgrove, Pa., May Be Site of Superpower Plant.—The Pennsylvania Realty & Investment Company of Allentown, Pa., has just taken title to 38 acres of land at Hummels Wharf, 2 miles north of Selinsgrove, across the river from Sunbury. The property will be turned over to the Pennsylvania Power & Light Company, which is expected eventually to build there a superpower steam plant to be tied in with the contemplated 220-kv. transmission system of the company, of which the first link—from Hawley to Siegfreid—will, as reported last week (page 1069), soon be under way.

Oklahoma Power Company and City of Okemah Come to Agreement.—By a vote of four to one the citizens of Okemah, Okla., have ratified, subject to legislative sanction, an agreement to sell their municipal plant to the Oklahoma Power Company and grant it a franchise, thus ending a controversy of three years' standing caused by legal action on the part of certain citizens to invalidate a contract entered into between the city and the company for the purchase of energy from the latter. This contract was sustained by the Supreme Court of the state.

Another Iowa Municipal Line Gives Up.—At a recent special election at Alta Vista, Iowa, citizens voted three to one in favor of selling the electric transmission line between Elma and Alta Vista to the Consumers' Power Company of Osage, Iowa. The line is owned by the town of Alta Vista. By a similar vote the people declared in favor of an ordinance granting a twenty-five-year franchise to the Consumers' Power Company to operate and extend the line in and through the town of Alta Vista and approved an agreement whereby the town is to purchase its energy for a period of ten years from the Consumers' Power Company.

Byllesby & Company Move General Offices.—H. M. Byllesby & Company have moved their general offices in Chicago to the eleventh floor of the Illinois Merchants' Bank Building, 231 South La Salle Street, which has been fitted up in a manner to facilitate to the utmost handling the details of the immense business for which it is headquarters. About five hundred executives and employees, including financial, engineering, accounting and utility operating specialists, are now housed there.

Another Prospective Bidder for Norwich (Conn.) Municipal Plant.—In connection with the reported offer made through Bodell & Company for the municipal plant of Norwich, Conn., the Eastern Connecticut Power Company of that city has written to city officials indicating that if the citizens decide to sell the plant it wishes to be privileged to bid for the charter and property. This company made the original offer for the plant. Authority will have to be obtained from the Connecticut General Assembly before it can be sold.

First 10,000-Volt Line Goes Out of Service.—Riverside, Cal., claims the distinction of being the pioneer in the transmission of electrical energy at 10,000 volts, a line with this capacity having been built from Mill Creek, above Redlands, to Riverside in 1896. Previously the highest transmission voltage in use was 5,000. Recently the old line was sold to the Southern California Edison Company with the exception of that portion within the Riverside city limits. The Edison company has just finished rewiring the line to carry 30,000 volts, a capacity necessary to handle the increasing use of power in Riverside.

Holtwood Steam Plant to Use Pulverized Coal.—The Pennsylvania Water & Power Company has decided upon the use of pulverized coal for firing the boilers at its new steam plant at Holtwood, Pa., and a contract has been given for a complete equipment for handling between 350 and 400 tons of coal per day. This plant, as already reported, will adjoin the existing hydro plant and will have an ultimate capacity of 100,000 kw. with an initial installation of 20,000 kw. It will be tied in with the lines serving the Consolidated Gas, Electric Light & Power Company of Baltimore.

Irrigation District to Furnish Power from Okanagon River.—Construction of a hydro-electric plant with a capacity of 3,000 hp., at an estimated cost of $300,000, is indicated in an application for permission to divert 2,000 second-feet of water from the Okanagon River filed with the State Supervisor of Hydraulics by the Riverside Irrigation District, Okanagon County, Wash. A 15-mile transmission line and a distribution system are estimated to cost an additional $125,000. The power will be used for irrigation pumping and for lighting and power service to Riverside and other small communities.

Turner Shoals (N. C.) Station Near Completion.—The Turner Shoals station of the Blue Ridge Power Company, which has been under construction on the Green River near Mills Springs, N. C., for about sixteen months, is nearing completion and it will be ready for operation in about six weeks. Its completion will make available some

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 5 issue, page 50, for latest list.]

Georgia Electrical Association—East Lake Country Club, Atlanta, Nov. 26. W. W. Barr, Georgia Railway & Power Company, Atlanta.

American Society of Refrigerating Engineers—New York, Dec. 1-3. W. H. Ross, 35 Warren St., New York.

American Society of Mechanical Engineers—New York, Dec. 1-4. C. W. Rice, 29 West 39th St., New York.

American Society of Agricultural Engineers (Farm Power and Machinery Division)—Great Northern Hotel, Chicago, Dec. 3. Raymond Olney, Mount Clemens, Mich.

Empire State Gas & Electric Association, Electric Division — Syracuse, Dec. 4-5. C. H. B. Chapin, Grand Central Terminal, New York.

West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers — Frederick Hotel, Huntington, W. Va., Dec. 12-13. Herbert Smith, Room 211 Robson-Prichard Bldg., Huntington.

Kentucky Association of Public Utilities—Louisville, Jan. 15-16. E. F. Kelley, Louisville Railway Co., Louisville.

Western Association of Electrical Inspectors — Brown Hotel, Louisville, Ky., Jan. 27-29. G. M. Miller, 1304 South Seventh St., Louisville.

Wisconsin State Association of Electrical Contractors and Dealers—Pfister Hotel, Milwaukee, Jan. 28-30. H. M. Northrup, 23 Erie St., Milwaukee.

7,300 additional horsepower for distribution in Spantanburg, S. C., and territory surrounding, and in conjunction with the station at Tuxedo, which has been in operation since the fall of 1920, will give the Blue Ridge Power Company a total capacity of about 14,000 hp. in addition to that developed by emergency steam plants in various mills. P. L. Holland is resident manager for the Spartanburg district.

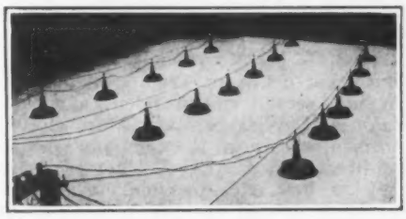
Farmer Gets $600 for Expected Interference of Transmission Line with Radio.—Notwithstanding that, as previously reported in these columns, farm owners have lost suits brought against the Milwaukee Electric Railway & Light Company because of the alleged interference of its transmission lines with reception on their radio sets, a condemnation commission has established a precedent in Wisconsin by awarding $600 in damages against the company to a farmer in the town of Greenfield, the award being based on radio interference from wires which are to be strung across this farm property, besides added damages for the erection of a steel tower on the same farm.

Protest Filed Against Lewis River Plant.—A protest against the proposed four-million-dollar 60,000-hp. water-power development by the Northwestern Electric Company of Portland on the Lewis River has been made in a complaint filed with the Supervisor of Hydraulics by George H. Funk of Olympia, who owns land that would be rendered incapable of access by the proposed dam. Mr. Funk denies that the power plant would be for the benefit of Washington, because virtually all power developed would be transmitted to Oregon. He maintains that the company's power plant on the White Salmon River has a generating capacity of 18,000 kw., of which only about 300 kw. has been used for public service in the state, the remainder being used by a paper mill or transmitted to Oregon.

Washington Water Power Company Has Hallowe'en Float.—Conspicuous in the Hallowe'en parade held in Spokane, Wash., according to local custom, on the evening of October 31 was the float of the Washington Water Power Company. This carried a large painting of the Long Lake station and Spillway dam, brightly illuminated by footlights. In order to carry out the Hallowe'en idea the float was decorated with suitable pictures and illuminated pumpkins. A devil armed with an electric fork made desperate jabs at a Hallowe'en cat, which responded to his efforts by spitting blue sparks six inches long, accompanied by a crackling noise.

Barstow Interests Will Take Over Three Companies in Eastern Pennsylvania.—The General Finance Corporation of New York City, a Barstow concern, has purchased an interest in three companies in Berks County, Pa., as a preliminary step to their acquisition about the first of the new year. These companies are the Hamburg Gas & Electric Company, the Topton Electric Light & Power Company and the Weisenberg Township Electric Light & Power Company, which have all been owned by the same local interests. In the last thirteen years their customers have grown in number from 195 to 2,250 and their gross revenue from $9,000 to $190,000. They will be operated as a unit for the Barstow Management Association, under the direction of A. J. Althouse, now associated with the Metropolitan Edison Company of Reading, who has as well been manager of the three plants named for periods of thirteen years, four years and one year respectively.

Speeding Nature Up by Electricity.—The new million-dollar Bradley Beach Golf Club at Bradley Beach, N. J., put its practice green into use two months after it was seeded by the help of artificial light. "Creeping bent," said to be the best but most difficult golf grass to grow in this country, was put in by Peter Henderson & Company and twenty-four 1,000-watt lamps in reflectors were installed by the Westinghouse Lamp Company and kept burning part of each night for three weeks. It is held that golf ground owners can



save considerable money by speeding nature up on their courses in this way, as the playing revenue received for the six or seven months' earlier use more than pays for the lamps and electricity. The reflectors on the golf green were suspended from cables at a height of about 4 ft. from the ground and about 7 ft. apart, furnishing an even light over the whole area. The grass seed under the lights came up in five days, while on the rest of the course it took two days longer. At the end of six weeks the grass under the lights had reached a growth of 4 in., while that outside the lights was only 1 in. high. It was also found that the grass under the lights was much thicker, and there were not nearly so many weeds on the green, probably because the grass was sturdier and heavier. In forcing the growth of the grass the illumination was kept on for five hours every night, the remainder of the time being allowed the grass for "rest."

Canada May Come Within Scope of International Power Securities Corporation.—According to statements current in Montreal, it is not improbable that the International Power Securities Corporation, the new name of the Italian Power Company, may in the near future play a part in the development of hydro-electric energy in Canada. As its name implies, the company is to be international in scope and its president is J. E. Aldred, president of the Shawinigan Water & Power Company, while Howard Murray of Aldred & Company, vice-president of the Shawinigan Water & Power Company, is a director. In explaining the change of name Mr. Aldred said that it had been decided to broaden the scope of the company's operations to include other European countries besides Italy, and power companies in Canada as well.

Kentucky Utilities Company Finishes 140-Mile Transmission Line.—One hundred and forty miles of 66,000-volt transmission line was opened up on October 30 by the Kentucky Utilities Company between Shelbyville and its new power plant near Pineville. The line supplies energy to operate construction machines at the Dix River dam, and to Danville, London, Lancaster, Springfield, Lebanon, Eminence, LaGrange, Pleasureville, New Castle and Shelbyville, Ky. The main line will be extended into Louisville and thence across the river to Jeffersonville, Ind., where it will connect with lines of the Interstate Public Service Company. This connection will be made in less than two months, engineers of the Kentucky Utilities Company estimate. When the Dix River project is finished, the hydro-electric plant and the Pineville power station, situated near coal mines where fuel is abundant, will be linked together.

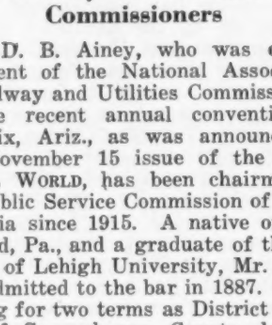
Program of West Virginia-Kentucky Association of Engineers. — At the fourth annual convention of the West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers, to be held at the Frederick Hotel, Huntington, W. Va., on December 12 and 13, F. M. Reigher will discuss "Rotary Converters as Compared with Motor-Generators," Byron B. Minnium "Voltage Control in Mines by Use of Storage Batteries," F. A. Signer "Electric Department Methods of the Southern Mining Company," and J. H. Edwards "Reducing Cost of Proper Supervision of Mechanical and Electrical Equipment." There will, besides, be open discussions on the prevention of theft of lamps and rosettes, co-operation between mine foremen and electricians, installing feeders in bore-hole installations, repairs by electric welding and the correct application of carbon brushes for flush and undercut mica segment commutators.

Electrically Operated Paper Mills Called Most Efficient in Pacific Northwest.—The new electrically operated plant of the Columbia River Paper Mills in Vancouver, Wash., unique among such factories in the Pacific Northwest, is one of the most modern in the United States. Materials flow through it, from raw stock to the finished product, in one continuous straight line without crossing each other at various points, this straight-line method of manufacturing having proved to be the most economical. Almost every piece of machinery in the sawmill and the "chippers" is electrified with individual motor drive, which eliminates all belting and basements. The operation of the paper machine is controlled entirely from conveniently located push-button stations. This modern electrically driven machinery, all of Westinghouse manufacture, is expected to break many existing records for economic and quantity production.

Men of the Industry

W. D. B. Ainey New President of Railway and Utilities Commissioners

W. D. B. Ainey, who was elected president of the National Association of Railway and Utilities Commissioners at the recent annual convention in Phoenix, Ariz., as was announced in the November 15 issue of the ELECTRICAL WORLD, has been chairman of the Public Service Commission of Pennsylvania since 1915. A native of New Milford, Pa., and a graduate of the law school of Lehigh University, Mr. Ainey was admitted to the bar in 1887. After serving for two terms as District Attorney of Susquehanna County, he was elected in 1911 to Congress, spending



W. D. B. AINEY

four years in Washington as a member of the Sixty-second and Sixty-third Congresses. Upon the completion of his second term he was appointed to the Public Service Commission by Governor Brumbaugh and three months later he was made chairman. Mr. Ainey performed the duties of this office so capably that in 1917 he was reappointed for a ten-year term. That his legal attainments have had wide recognition is evidenced by the numerous occasions on which he has served as a delegate to international gatherings, including the Interparliamentary Conference in Geneva, Switzerland, in 1912 and the Hague Conference in 1913, where he was made secretary of the Japanese-American groups of parliamentarians. In 1914, on the invitation of the Imperial Parliament, he visited Japan as a delegate from the United States.

B. P. Shearon has resigned as comptroller of the Northern Indiana Gas & Electric Company to become assistant treasurer of the Midland Utilities Company with headquarters in Chicago. Mr. Shearon has been in the public utility business since 1907, starting as an employee of the Lafayette (Ind.) Gas Company. This company later became a part of the Indiana Lighting Company, which in 1916 was merged with the Northern Indiana Gas & Electric Company. When the general offices of that company were established in Hammond, Mr. Shearon moved there as assistant treasurer and was appointed comptroller of the company in charge of accounts in 1918. He has been active in the affairs of the National Electric Light Association and the American Gas Association, having served as a member of many committees of these bodies.

W. C. Marmon Elected President in Indianapolis

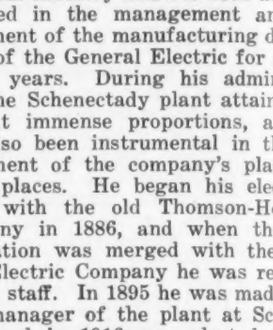
Walter C. Marmon has been elected president of the Indianapolis Light & Heat Company to succeed the late Charles C. Perry. In serving as president of the company Mr. Marmon will follow in the footsteps of his father, Daniel W. Marmon, who was president until his death in 1909. Thomas N. Wynne, second vice-president, and Norman A. Perry, secretary, were elected to membership on the company's board of directors. Charles N. Thompson was elected first vice-president to fill the vacancy caused by the promotion of Mr. Marmon, who had held that position since the death this year of Thomas A. Wynne.

Frederick W. Bliss, since 1910 in charge of sales in southeastern New England for the Edison Lamp Works of the General Electric Company, with headquarters at Providence, R. I., has been elected chairman of the New England district of the Associated Advertising Clubs of the World. He is also president of the Providence Engineering Society.

H. G. Winsor of Tacoma, Wash., has been appointed to the newly established position of personnel officer of the Puget Sound Power & Light Company. Mr. Winsor, with headquarters in Seattle, will report to the vice-president. He will have general charge of the development of relations with employees, personnel records, company welfare work, retirements and pensions, group insurance and the establishment of mutual benefit associations.

G. E. Emmons, General Electric's Retiring Vice-President

George E. Emmons, who, as was announced in last week's issue of the ELECTRICAL WORLD, has asked to be relieved of his duties as vice-president of the General Electric Company in charge of manufacturing, is a pioneer in the electrical industry and has been actively engaged in the management and development of the manufacturing department of the General Electric for nearly thirty years. During his administration the Schenectady plant attained its present immense proportions, and he has also been instrumental in the development of the company's plants in other places. He began his electrical work with the old Thomson-Houston company in 1886, and when that organization was merged with the General Electric Company he was retained on the staff. In 1895 he was made general manager of the plant at Schenectady and in 1916 was elected to the office of vice-president. Two years ago



G. E. EMMONS

Mr. Emmons was decorated by the Japanese government in recognition of his services in introducing electrical machinery into Japan and of his contributions to the development of the electrical industry in that country. In commenting on his resignation, Gerard Swope, president of the company, said: "Mr. Emmons has served the company loyally, whole-heartedly and indefatigably for almost forty years. He has met his arduous responsibilities not only with outstanding ability, but in a manner which has won and held the respect and affection of workers in all grades of service throughout the organization."

Obituary

Albert Wurster, an electrician employed by the Public Service Electric & Gas Company of Newark, N. J., lost his life November 18 in the city dock power plant of the company. In some way a short circuit occurred and the flames, catching to the insulation, cut off his means of escape. Mr. Wurster was a recipient of the Insull medal, which was awarded to him last May at the convention of the National Electric Light Association in Atlantic City for saving the life of an electrical helper who had touched a high-tension wire in the Plank Road power station of the company.

Gabriel Henry, chief engineer of the Ministry of Highways of Quebec, died October 9 in his sixty-second year. A native of Ardennes, France, and a graduate of the École Centrale at Paris, Mr. Henry migrated to Canada, where later he distinguished himself as a member of the Ministry of Highways of Quebec in promoting the excellent work which has been done on the highways.

Recent Court Decisions

Tenant of Grantor of Right-of-Way Cannot Recover Damages Incurred Through His Trespass.—The Supreme Court of Oregon, rehearing Kesterson vs. California Oregon Power Company (see ELECTRICAL WORLD, March 8, page 501), has reaffirmed its decision that a tenant of the grantor of a right-of-way to the power company could not, being a trespasser, recover damages from the latter for the loss of lumber which he piled on the right-of-way and which was destroyed by fire caused by a broken transmission wire. (228 Pac. 1092.)*

Municipality Cannot Contract for Specific Franchise Rate in Nebraska.—The Nebraska Gas & Electric Corporation has won a preliminary battle in the United States District Court at Lincoln with the city of Beatrice, which sought to reduce gas rates from $1.90 to $1.70 a thousand. The master who took the testimony finds that the rate would be confiscatory because it would yield only 3 per cent on the actual investment, when the company is entitled to 7½ per cent. An important point decided is that under the Nebraska law a municipality is powerless to contract with any utility for a specific rate as a consideration for granting it a franchise.

If Coal Company Furnishing Power Only to Lessees Subsequently Becomes a Public Utility, Its Original Contracts Are Still Binding.—A coal company owning a large area of coal lands subdivided them and at various times leased the subdivisions to divers lessees for development. In its lease it agreed to erect or cause to be erected an electric power plant, centrally located, from which electric power should be sold and delivered to the respective lessees at such point as should mutually be agreed upon between the lessor and the lessee, if such point were other than at the mines of the lessee. The Supreme Court of Appeals of West Virginia has held (Hodred Collieries of West Virginia vs. Boone County Coal Corporation) that the coal company was not then engaged in public utility service, though within the period the leases were being made it organized a subsidiary company and caused it to construct and operate an electric power plant for the purpose of furnishing electric power to its lessees pursuant to the terms of the leases. The company's contract to furnish electric power to its lessees was a private contract, the court says, in which the public had no concern and was therefore not subject to public service regulation. When, however, the subsidiary power company of the coal company extended its service to the public generally and was therefore declared by the Public Service Commission to be a utility, it was allowed by the commission to increase its rates beyond those fixed in the coal-mining leases. This action is disapproved by the court, which declares the assignee of the lessee concern entitled to recover from the lessor the difference between the maximum rate fixed in its lease and the rate it was compelled to pay. The lessor could not be relieved from its contract obligation merely because it had become burdensome by reason of increased costs. (124 S. E. 493.)

Prudent-Investment Method of Valuation Not Unconstitutional.—In affirming warehouse rates established for the Pacific Coast Elevator Company, which appealed against the order of the Department of Public Works, the Supreme Court of the State of Washington said that the prudent-investment method used in establishing the rate base, by which the elevator company was allowed an income slightly in excess of 10 per cent on moneys prudently invested, plus a reasonable operating surplus, was not in violation of the United States Constitution. The allowance of one-sixth of previous year's operating expenses as necessary working capital was held sufficient. Warehouses not used were properly excluded from the valuation. (228 Pac. 1022.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Comparison of Rates Between Small and Large Companies Not Tenable.—Dismissing a complaint made against the rates of the Hightstown Electric Light & Power Company, the New Jersey Board of Public Utility Commissioners said that evidence to show that existing rates afford more than a fair return upon the value of utilty property should be produced in a proceeding in which the reasonableness of these rates is challenged. It declared, besides, that a complaint that rates of a small electric utility serving a single municipality are unreasonably high is not sustained by evidence that a large utility serving numerous municipalities from a single generating plant charges lower rates. In the case at issue it was alleged that there was too great a disparity between the rates charged by the Hightstown company and those of the Public Service Electric Company, from which it buys energy for resale.

Overhead Wires in Smaller Cities Not a Menace. — A decision of importance to electric and telephone companies operating in Wisconsin, especially those supplying service in the smaller communities, has been handed down by the Railroad Commission of Wisconsin in a complaint brought by the city of Racine, which appealed to the commission following the refusal of the Milwaukee Electric Railway & Light Company and the Wisconsin Telephone Company to remove their wires and poles and substitute underground equipment. In dismissing the city's plea the commission found that the poles in question did not constitute a menace except in a few cases where poles were erected in street gutters. The commission pointed out that placing wires underground would bring an additional burden to the companies and subscribers alike which would obviously have to be met through higher rates.

Definite Information Must Be Given When Sanction Is Sought for Bond Issue.—Granting in small part only an application from the Arkansas-Missouri Power Company for permission to issue bonds and withholding (without prejudice) consent to the major part of the issue, designed for the "prospective acquisition of other properties now under negotiation," the Missouri Public Service Commission said that an issue of bonds for the purchase of property should not be authorized when there has been no definite showing as to the value of the property to be purchased and the price to be paid therefor, or whether the terms of purchase of any particular properties have been agreed upon.

New Jersey Municipal Plants Not Exempt from Observance of Commission Rules.—Inasmuch as the New Jersey home rule act provides that a municipally operated electric utility shall conduct its plant and operations in accordance with the same general rules and regulations prescribed for other electric utilities, and since the New Jersey public utilities law provides that every municipality operating any form of public utility service shall keep the accounts thereof in the manner prescribed by the board for the accounting of similar public utilities, and shall file with said board such statements thereof as may be directed by it, the New Jersey Board of Public Utility Commissioners has ordered the municipal electric plant in Sea Isle City to comply with the recommendations for repairs and improvements made by the board's engineer and also to file its annual report for 1923, both of which it had neglected to do.

Wholesaling of Power to Local Companies Approved by Massachusetts Commission. — In granting the New England Power Company permission to construct a transmission line from its Uxbridge plant to a substation of the Draper Corporation in Hopedale, Mass., in order to furnish power to that corporation, the Grafton & Upton Street Railway and the towns of Hopedale and Milford, the Massachusetts Department of Public Utilities observed: "It appears that the companies now furnishing service in this field have reached their capacity of production and must enlarge and extend their existing plant and property in order to enable them to render adequate service to their customers or must purchase electricity from other sources. If each of the companies is obliged to enlarge its plant, it would be some time before the increased demand would approach the increased capacity. It appears that the companies can be taken care of more economically by purchasing the additional electricity required from the petitioner. This ought to work to the benefit of the public, as economical operation means lower rates, and it appears that the petitioner will be able to render to these companies and to other customers adequate and dependable service."

Manufacturing and Markets

Service Problems of Distribution

Wholesaler's Analysis of Published Study by Association of Electragists' Merchandising Policy Committee at the West Baden (Ind.) Convention*

By W. R. Herstein
Vice-President Wesco Supply Company, Memphis, Tenn.

I AM requested to discuss from the standpoint of the wholesaler the bill of particulars presented by the special committee on merchandising policies of the Association of Electragists International. For that reason I will confine my remarks to the specific points presented by the committee in its widely published report entitled "Reasons Why the Electragist Does Not Receive Adequate Reward for Service." A critical observer might point out to the committee that the term "reward" is not sufficiently defined in the title or in the subject matter of the report. Does the committee have in mind the immediate reward for service involved—namely, the difference between cost and selling price—or that less definite but more desirable reward expressed in terms of financial and social standing after the dealer has been subjected to the test of business for a number of years and is nearing the twilight of his active career? A fair-minded consideration of the report must assume that the committee had both these aspects of reward in view, and fortunately the seven points specifically covered by the report are wide enough in range to permit discussion of the questions of both proximate and ultimate rewards.

With this premise, I shall now take the committee's specifications point by point and discuss them from the plane of the jobber; and when I say jobber, please bear in mind that I use the word in its plainest and simplest sense, as I understand it. It precludes the idea of a jobber being anything else—retailer, contractor, manufacturer, broker, engineer or any of the other functionaries making contact with the industry.

Power Equipment

1. "That manufacturers and wholesalers are selling direct to consumers materials and equipment that require the functions of the electrical contractor to install, placing the burden of responsibility for satisfactory operation on the contractor, through whom in the normal course of business the sale should have been made."

The first specification in the report refers principally, I take it, to the sale of power equipment, a line of material with which most jobbers have very little to do. The majority of jobbers have long realized that whoever sells apparatus to a user assumes, either voluntarily or involuntarily, an obligation to service the apparatus for an indefinite length of time. The pitifully small discounts accorded the jobber on this class of material provide compensation neither for servicing nor for the intensive sales effort usually accompanying such transactions. Even the gross profit earned by the contractor is inadequate and must be supplemented by a profit on the work of installation. I do not believe, therefore, that the jobber is very largely an offender on count No. 1 of the indictment; and if he is, the taking of the business acts as its own punishment. So far as the manufacturers are concerned, my observation has been that competition between them on power apparatus is very keen. When three or four of them go into the ring together the result is a battle royal, and any jobber or contractor who takes a hand in the fight is only inviting an inevitable knockout.

Selling the Consumer

2. "That manufacturers and wholesalers are selling direct to consumers materials and equipment to be installed by the consumer, where the consumer is not competent to make such installations."

I am compelled to admit that this point is more embarrassing. Not embarrassing because the jobbers are willfully guilty of being unfair to the contractor-dealer, but because of the wide twilight zone that exists between what the jobber should and should not do. The jobber's very existence depends upon his low operating expense. Industry will not pay him the percentage of profit it pays the retailer, and the larger his volume of sales per customer, the better chance he has to survive.

Industrial business, as it concerns electrical materials, may be roughly grouped into three classes—first, the character of business I have just mentioned, where the buying is always small and lends itself easily to retail practices; second, where the buying is on a very large scale, competition more or less keen, and the volume ranges beyond the capacity of the average retailer's capital investment; third, where purchases are occasionally quite large but usually in retail quantities.

Most jobbers gladly concede the small business to the dealer, and the jobber competition encountered by the retailer comes either from the small class of concerns which do not seek contractor business and which are really retailers themselves, though passing more or less successfully as jobbers, or else from the bona-fide jobber who, small in number as in caliber, willfully ignores his obligation to his customers and to the industry. I have a remedy to propose later for this type of individual.

As to the second class, the committee virtually recognizes the propriety of direct contact between buyer and jobber. The majority of contractors frankly do not seek this business. Few retailers care to bid on cables, conduits and fittings, control apparatus, or even industrial reflectors, running into the thousands of dollars; and even if secured, the business could not possibly yield a profit comparable with a retailer's overhead.

It is with reference to the third class of industrial buyer that I personally have encountered the greatest embarrassment. An industrial reported to be in the market for a considerable quantity of electrical material immediately attracts general attention. Retailer and jobber submit prices and the jobber gets the business. For months thereafter the jobber continues to get the concern's orders, usually in con-

*Address delivered October 1, 1924.

stantly diminishing amounts, until the business, at wholesale prices, becomes unprofitable and the customer a pest. Even if the jobber has the backbone to ask retail prices, he finds that he is not equipped to give retail service, and that no price he could possibly charge for a couple of 60-amp. fuses will pay the expense of delivery, unless, like the retailer, he has a light truck maintained solely for the purpose of delivering to retail customers.

The problem is not simple. It is difficult for a jobber to refuse to quote on an industrial order of considerable size, even though he feels that after filling the initial order the customer will become a liability instead of an asset. It is equally difficult to advise retailers to solicit this character of one-time big buyer, particularly in view of the impossibility, usually, of telling in advance whether he is really going to be a one-timer or a repeater. Under the circumstances, jobber and retailer will inevitably be thrown into competition one with the other, and friction can be avoided only by the exercise of a broad spirit of tolerance by both.

RETAILING BY JOBBER

3. "That wholesalers, receiving a maximum differential on all goods handled by them, such discount being designed to be divided between themselves and the retailer, are using that maximum discount to perform only a retail service on a part of their sales, thus setting up false standards for the basis on which actual retail business can be operated at a profit."

I am disposed to concede the committee's stand on the question of the jobber engaged in retail business. Particularly am I inclined to condemn the jobber who sells at retail while claiming to be a wholesaler exclusively. Thus it happens that friends of the jobber or of his employees buy much of their electrical appliances at wholesale prices, and these people often purchase on behalf of their own friends. In this manner, the retailer frequently loses the sale of a major appliance, after he has brought the customer to the buying point, by some zealous outsider with a friend in the jobbing house intervening and securing direct contact between jobber and consumer.

In my own business we have been compelled to discontinue reciprocal trade relations with local jobbers in other lines because we found employees of such jobbers buying our goods for their friends and depriving our regular dealers of the business. We have been able to combat this evil only by establishing a firm rule that we will not deliver electrical material in Memphis to any one but an established dealer.

I think there can be no question that the jobbers as a class discountenance retailing by jobbers and that the practice is diminishing. I have talked with a number of those still engaged in retailing, and almost without exception they declare their intention of withdrawing as soon as their present leases expire, or whenever a favorable opportunity to leave the retail district presents itself. There will always be a few engaged in retailing under exceptional circumstances, but ultimately little occasion will remain for complaint. By far the greatest annoyance will be caused by the retailer himself who is emerging into the jobber class and who has induced certain manufacturers to sell goods to him at wholesale which he disposes of at retail—but of him more anon.

OVEREXTENSION OF CREDIT

4. "That many jobbers are extending lines of credit to contractors and dealers not commensurate with the responsibility of such customers, thereby encouraging speculation by inexperienced men in creating an unfair and an uneconomic competition that is demoralizing to the established and responsible business."

This has some foundation in fact, but not to an extent that imperils the jobbing or contracting industry. After twenty years in the jobbing business I count among my successful customers many whom years ago it was my privilege to assist financially in times of stress. The record of credit losses of our Memphis house over that period shows an average of a quarter of 1 per cent. This record compares favorably with that of jobbers in other lines. I do not deny that there are those among us who are notoriously lax on credits, but the sin brings its own punishment, and you may feel safe in letting nature take its course.

I think the committee is wrong in its deduction that competition between jobbers induces the jobber to set up in business irresponsible and inexperienced men as contractors in order to use them as a channel through which to sell their goods. I have heard of few cases where jobbers deliberately induced new and untried men to go into the electrical contracting business on the jobber's capital. What frequently happens is that a jobber securing little or no business in a given community will grasp the opportunity offered by the entrance of a new factor into the contracting situation and will accord a line of credit in keeping with the judgment of his credit department. A credit risk of this character is not inconsistent with sound business practices. The usual occurrence, however, is that the new factor starts in with a knowledge of wiring and enough money to take up a C. O. D. shipment. If, in addition to these, he has reasonable business ability, his purchasing power in the course of months or years attracts attention from the jobbers, and his permanency in the field, with the acquisition of a stock of merchandise, establishes his right to a reasonable amount of credit. I believe I may safely say that this is the beginning of the life history of nearly every contractor in the business.

It is unfortunately true that in our industry we have an unusually large proportion of customers whose capital is not commensurate with their business opportunities. To a very large extent the jobber is compelled to supply this capital, and his success in business depends largely upon his discretion in meeting the demands made upon him. When application is first made, it is difficult to tell whether the applicant will prove a credit loss or whether he will develop into one of those contractors whom every jobber must have on his books if he himself is to succeed in business. A cautious and judicious extension of credit is the only answer to this problem, and equally unfortunate is the jobber who grants an over-extension of credit and the jobber who is too slow to recognize merit in a rising and capable young contractor.

POWER SALES POLICY

5. "That lack of definite sales policies on the part of the larger manufacturers and jobbers and their salesmen is responsible for a lack of confidence on the part of the contractors and retailers."

The charge of a lack of definite sales policies is a trifle vague. Possibly the trouble is not that definite policies are lacking, but that the policies of many manufacturers and jobbers as they now exist do not suit contractors. On the other hand, however, the contractors themselves are to a degree responsible for this situation. I do not know just how largely you figure in the calcula-

tions and the necessities of the manufacturers, but to the average jobber you are as vital as the air he breathes. Without your support and patronage few jobbers can remain in business. Why you do not recognize and take advantage of this fact is one of the world's great, unsolved riddles. And yet, every day, you give your encouragement and business to jobbers who have no policy or, if they have one, give you and your prosperity no place in its provisions. The majority of you seem to have an idea that the contracting industry will take care of itself and that you, therefore, individually have no responsibility in the matter, or else that the case is hopelessly without remedy and that it is not worth while to try. You go on, day after day, year after year, buying on the basis of price alone, giving no thought to the question of whether you are building up a friend or an enemy, thinking only of today's dime rather than tomorrow's dollar.

In complaints 1 and 2 you denounce the jobber who sells to your customers. Did you ever refrain from patronizing such jobbers if their prices were lower than those of the fellow who is playing your game? Have you any idea as to what constitutes the mailing list of the so-called cash or mail-order houses? Yet, I dare say, there are more than one of you who send them your orders in the same mail that carries the orders of your own legitimate customers.

You have a tremendous influence if you would only use it. The word "boycott" is a harsh term and I hesitate to employ it, yet it is the only argument some of the jobbers will understand. Patronize the jobber who protects your interest; refrain from patronizing the jobber who refuses. I am speaking to you individually, not collectively.

If you will leave this meeting determined individually to support only the jobbers who have what you consider a correct policy and determined to influence your stay-at-home competitors to do likewise, your committee will soon be able to report that on this count, at least, the indictment is dismissed.

I imagine none of you will deny that if oxygen and hydrogen produce water, so do hydrogen and oxygen. The same elements combine to make the same thing, regardless of which is mentioned first. A jobber who is also a contractor constitutes a thing abhorrent to this association. By all the rules of reason should not a contractor who poses as a jobber be stamped with like odium? Certainly the purposes of the committee's report will never be attained until this fact is recognized and properly acted upon by yourselves as well as the jobbers.

Then there is another problem which confronts every jobber and causes him perpetual embarrassment. This is the case of the successful contractor who discounts his bills, whose business is eagerly sought and whose purchasing power and local influence are considerable. If there is a tendency on the part of the jobber to go over the head of the retailer in his selling efforts, the tendency of the successful contractor to seek direct contact with the manufacturers is immeasurably more pronounced. This matter has not received the publicity it deserves because the number indulging in the practice is comparatively small, yet sufficiently important to cause serious embarrassment to jobbers who are making an honest effort to sell to the dealer and not to the dealer's customer.

MANUFACTURERS' SECRECY

6. "That the margins of discounts to retailers on many lines of goods, especially appliances, are insufficient to cover the cost of adequately serving their communities and leave a fair compensation;" and

7. "That such insufficient margins of discounts to retailers on many lines are encouraging those who can do so to seek wholesale discounts on various pretexts, thereby still further upsetting the balance of distribution through an unequal compensation."

Since, as a jobber, I freely concede the fact that dealers are inadequately compensated for the sale of shelf, counter and other retail appliances, it would seem that argument on this question should be addressed to an association of manufacturers rather than to a group of electragists. But did you ever consider the fact that you have never had an opportunity of addressing the manufacturer? Your own meetings are open to the world; so are those of the central stations and the jobbers. The manufacturers alone continue to work out their problems without the collaboration of the other branches of the industry, and their ideas on adequate compensation to their distributors and retailers are necessarily one-sided. It is to be regretted that the manufacturers have not been as open concerning their affairs as have the dealers and jobbers. Your association's published study on the "Cost of Doing Business Among Contractor-Dealers" places valuable information in the hands of the industry. The Electrical Supply Jobbers' Association, in the admirable report compiled by the sub-committee of its committee on accounting and statistics, presented to the industry a study extending over a period of eighteen months, containing an exposition of the jobber's cost of handling forty-five major lines, the accuracy of which was vouched for by one of the most prominent firms of public accountants in the country. No one save the manufacturer, however, knows how the compensation he reserves for himself compares with that he accords those who serve him. Whether this be adequate, great or little, we can only vaguely conjecture.

If the manufacturer would take the dealer more into his confidence and counsels, great good could be accomplished. If it appeared that the manufacturer's compensation was already small, the advisability of increasing both his and the dealer's profits by an increase in list could be discussed, since doubtless many meritorious devices are moving sluggishly not because their price is high but because it does not pay the dealer to push them. The more a dealer is paid, the more eagerly he performs his work. He will unquestionably do a better job selling a five-dollar article at $2 profit than selling the same article at $4 with a profit of $1. Give him a chance and then condemn him if he does not perform properly, but don't condemn him without giving him a chance.

INADEQUATE DISCOUNTS

It is unfortunately true, as the committee has ably pointed out, that discounts to retailers of electrical merchandise are not such as to attract the capital and ability which the industry needs. Ultimately this fact will be recognized and remedied. But will the present type of contractor-dealer survive to enjoy this benefit? Already those of us who prefer to confine our efforts to electrical channels are beginning to note a perceptible decrease in the number of responsible contractor-dealers and a deplorable diminution in the total volume of contractor-dealer business. In the section with which I am most familiar the effort to maintain neat and attractive electrical stores is visibly lessen-

ing. Competition from non-electrical sources is gaining headway, fostered largely by manufacturers and jobbers who have lost faith in the ability of the electrical man to represent them properly before the public.

We ourselves, as distributors, are having great difficulty in getting sufficient volume on certain merchandising lines to satisfy our manufacturers, and already we are receiving notices that unless we increase our purchases these manufacturers will either cancel our agencies or appoint additional distributors in our territory. On the very day these words are written we have received a letter from one such manufacturer withdrawing his discounts to us on the ground of insufficient volume. Many jobbers, like ourselves, are now confronted with the necessity of choosing whether they will stick to their old policy of selling to electrical dealers only, thereby confining their business to housewiring material, or abandon this policy and, in order to obtain the benefits of the opportunities offered by appliances and radio, seek outlets among the newcomers in the field.

The picture looks dark, but it is not without hope. The two plans suggested by the committee—namely, consignment and deferred compensation—appear to me to be too complicated, too inviting to those without capital and too dependent upon the agreement of thousands of different interests to be practicable, even if they are not clearly a violation of the laws of the land. The hope of the future, I believe, consists largely, possibly entirely, in the granting of better discounts to retailers. Already this remedy is under way. Ten years ago discounts of 25 per cent were high. Five years ago 30 per cent and better were common. Today 35 per cent and 40 per cent are not unusual. In my opinion, nothing less than 40 per cent will save the dealer.

Experience has shown that the modern type of retail store, with neat and intelligent salespeople, cannot be maintained for less. The manufacturers are recognizing this by according department stores and merchandising departments of central stations preferential or syndicate discounts ranging from 40 to 50 per cent. The manufacturers are not stupid, and they know that if these large interests need such discounts, even more does the small dealer require them. But these discounts have not been eagerly granted. They have been obtained by a show of strength and unity of effort on the part of the organizations of which these interests are members. Nor have the manufacturers lost by providing adequate compensation for these large outlets. Increased sales, increased output, mean decreased manufacturing costs, more popularity for their products, satisfied dealers and a nearer approach to sound and lasting prosperity. Why should not the electrical contractor-dealer share in all this? There is no reason save his own indifference, his own supineness and his own lack of unified effort.

With a unified and representative association under capable and unselfish leadership one may easily see down the vista of future years the electragist established upon his rightful plane among the business men of his community, commanding the respect and confidence of the other branches of the industry, and, so far as this world's goods are concerned, reaping finally the reward of intelligent effort properly applied.

Business Conditions

ENCOURAGING reports of a continued upward trend of business are being received. Many manufacturers are able to cite several cases where dormant projects have not only been vitalized, but plans have been materially increased and the attitude of the buyer has definitely changed from one of hesitation and uncertainty to a definite decision to proceed with deferred improvements. Prices are becoming firmer and there is much less tendency to offer concessions. Copper wire prices have again advanced.

The increased demand for iron and steel has caused these products to advance. The new bond offerings last week were led by the industrial group, and already this week $23,000,000 worth of public utility issues have been offered to the public. Secretary Hoover in his review of the economic progress of business conditions during the year ended June 30, 1924, with his conclusions as to the prosperity existing throughout the business world at that time, has encouraged industry. He also points out that European stabilization, which the Dawes plan may be expected to achieve, will bring about a revival in world trade and increased consumption of commodities. In this increased trade the United States is bound to have a share.

In New England business is gaining and bids fair to maintain its increase. A better tone is strongly evident in the New York district, there is a general increase in activity, and many dormant projects are being revived. In the Southeast many moderate-sized orders, spread over virtually all lines of electrical materials, are largely responsible for the good business reported. Buying of all commodities in the Middle West is good, and there is an active demand for auxiliary equipment and cable.

Foreign Machinery Competition in Japan Very Acute

A CONTRACT for the purchase of power-plant machinery and equipment valued at more than $1,000,000 has recently been signed by the Japan Electric Power Company of Osaka, according to an announcement of the Department of Commerce. The turbines and the condensers will be supplied by the Escher-Wyss Company; the Siemens-Schuckert Company has been awarded the contract for building the generators, and Babcock & Wilcox, through Mitsui & Company, will build the boilers. The auxiliary pump motors will be built by an American firm.

This contract has aroused considerable interest among various American and foreign concerns as the reason for the award of the major portion of it to European manufacturers is said to be that the bids by the American companies were approximately 40 per cent higher than those of their foreign competitors. The terms of credit granted on these orders will cover a period of three years.

Copper and Lead Sales Decrease —Zinc Active with Price Higher

THE demand for copper and lead has decreased, but zinc sales have been so good that the price advanced slightly. Speculation on the market, if present, is only a minor factor for the time being. Some producers have been able to obtain 14 cents for copper almost every day, but others have been shading this price to attract business. The steady advance that has taken place in copper is the result of good consumer demand. Producers, therefore, are unwilling to press sales.

Little business was done in lead, which remains at the same price. Sales of zinc continue heavy, galvanizers being the most interested purchasers. In unison with the demand the price has moved up somewhat. Tin prices have stiffened slightly, consumers being moderately interested in the market.

NEW YORK METAL MARKET PRICES

	Nov. 12, 1924 Cents per Pound	Nov. 19, 1924 Cents per Pound
Copper, electrolytic	13¼–13.95	13¼–14
Lead, Am. S. & R. price	8.65	8.65
Antimony	15¼	15
Nickel, ingot	29–30	29–30
Zinc, spot	7.15	7.25
Tin, Straits	54¼	54¼
Aluminum, 98 to 99 per cent	28	28

New England Business Gaining—Industrial Situation Improves

IN THE New England district business has been gaining and bids fair to maintain its increase owing to the improved industrial situation and the expansion of central-station activity. Recent electrical equipment sales include five heat-treating furnaces aggregating 200 kw. to the United Shoe Machinery Company at Beverly, Mass., and single furnaces to industrial plants at Worcester, Lynn and Winchendon, Mass. Small transformer buying is more active. An electric linotype-pot sale of four units has been made to the Haverhill (Mass.) *Gazette*. A Boston bank purchased $18,000 worth of lighting fixtures from a local jobber. Another jobber sold 1,000 chestnut poles last week for use in Greater Boston. Also a Vermont industrial plant purchased $10,000 worth of wiring material. Ninety-six vacuum cleaners were sold in Maine by a single house in the first week of a free attachment campaign, and one central-station syndicate reports total electrical appliance sales this year to November 1 of $401,925.

Despite the improvement in trade, jobbers are maintaining stocks readily, but the desire to keep inventories down may probably influence purchases in the next few weeks. Industrial sign lighting is reviving at Boston as a result of a campaign concentrated upon establishments located near railroads.

Buying in the Middle West Good on All Commodities

BUSINESS is appreciably better in the Middle West and optimism is prevalent everywhere. There has been an active demand for auxiliary equipment and cable. One central station purchased about 10,000 watt-hour meters, and a manufacturer of weatherproof cable reports having received a contract for upward of 1,000,000 lb. of weatherproof wire and cable. Another central station made a large purchase of lamps for the first quarter of next year. One manufacturer reports receiving an order for 300 high-tension fuses from a Philadelphia utility company. Numerous small substations are being planned and central-station expansion is proceeding rapidly. Pole-line hardware is much in demand, and there is also a good demand for poles. Prices, in general, are apparently firm.

Better Tone Evidenced in Business in the New York District

A DISTINCTLY better tone is becoming more and more evident in the business transacted in the New York district. There are more inquiries and a general increase in business activity. Industrial buying is improving, and many projects which have been lying dormant are now being actively revived with every indication of orders being placed—a condition quite opposite to the pre-election attitude of hesitation. Prices of raw material are holding firmer, and there is less of a tendency on the part of sellers to give cencessions, with the result that prices of manufactured articles are following suit.

One manufacturer reports that in the past two weeks more than one hundred thousand dollars' worth of insulators have been sold by him, 50 per cent of which is known to be for use in 1924. This total includes an order for approximately $70,000 covering insulators for South Carolina properties. It is reported that there is every indication that the construction programs of utility companies, as far as can be ascertained, will go forward at advancing rates in 1925. Street-railway business is becoming more active, one company planning to spend approximately $5,500,000 for new equipment. A particularly large increase in conduit sales is noted by some jobbers, with generally improved buying of all lines. Prices on this commodity are expected to increase shortly. High-grade radio sets are in especially good demand.

Steady Improvement of Business on the Pacific Coast

A FIRST rather feverish response of business to the presidential election on the Pacific Coast has speedily subsided to a steady and most encouraging improvement, practically every branch of the industry being appreciably benefited. Fiber rod and tubing prices have recently dropped about 10 per cent, and sales to various industrial plants are now providing an even better business than during the war years of motor shortage, when there was a consequent pressing of repaired motors into service and a good demand for these products. Wire has again advanced and further advances are anticipated. Stocks are good, but not unduly high.

Oil-service stations are continuing to be excellent sources of business, the electrical material for each running close to one thousand dollars. Holiday orders for appliances are now at full tide, the percolator and toaster being in particularly good demand. Several rural telephone companies have placed fair orders for cross-arms and hardware. The Alaska Engineering Commission, Bell Street Dock, Seattle, will open bids on November 28 for approximately $40,000 worth of pole-line equipment, copper wire, telephone apparatus, etc.

Many Orders Total Good Volume in Southeast

THE multiplicity of moderate-sized orders, in the Southeast, which are showing a tendency to increase in volume, is largely responsible for what is reported as the best business experienced since the end of the war. There have been no extraordinarily large orders, but the demand seems to be well spread over virtually all lines of electrical materials. Inquiries are also in hand for a considerable amount of industrial requirements. Reports are being received from all sides that the effect of the home-lighting contest is becoming apparent, as the demand for home-lighting fixtures continues to increase from week to week.

The demand for distribution transformers and house-type meters is very satisfactory, while an increase is being noted in the number of inquiries for high-tension transformers of the 11,000-volt to 38,000-volt type and sales of small motors of 100 hp. and less are reported on the increase. Christmas specialties are beginning to move in satisfactory volume, with appliances generally on a very active basis, and radio apparatus is extremely active, with the demand in excess of the supply.

Activities of the Trade

Philadelphia Storage Battery to Move Boston Office

On account of increasing business and lack of space in its present quarters, the Philadelphia Storage Battery Company will move its New England sales offices on November 25 from 740 Commonwealth Avenue to 1 Brighton Avenue, Boston. The Roberts Battery Company, New England distributor of starting, lighting and radio equipment for the Philadelphia company, will share the new offices. A stock and service station will be maintained at the new location. George W. Holden is district representative.

Westinghouse and General Electric Receive Railway Orders

The Illinois Central Railroad has contracted with the General Electric Company and the Westinghouse Electric & Manufacturing Company for motor and control equipment to be used in connection with the electrification of the suburban service in Chicago, aggregating $3,000,000. The electric control equipment has been ordered from the General Electric Company and the motor equipment has been divided equally between the General Electric and Westinghouse companies.

Sundh Electric Company to Enter Industrial Control Field

The Sundh Electric Company, Inc., 5 Avenue C, Newark, N. J., manufacturer of electric control apparatus, which previously has limited its operations to the manufacture of control equipment for pumps and office-building use, now announces its intention to enter the field of industrial control apparatus for factories, textile mills, railroads, etc.

In entering this new field the company as a beginning is placing on the market three across-the-line-type automatic starters—one with undervoltage release or undervoltage protection, the second having in addition inverse-time-limit overload thermal relay protection and the third being provided with inverse-time-limit overload relay protection. All these starters are manufac-

tured in either the open or inclosed type, two-pole or three-pole, for motors up to and including 10 hp., 220-440-550 volts. The company further announces its intention to get out a full line of equipment particularly adapted to industrial service.

General Electric 1924 Sales Estimated 12 per Cent Under 1923

It is estimated that sales of the General Electric Company for the entire year of 1924 will be about $265,000,000. This will represent a decrease of about 12 per cent from last year, when sales totaled $304,000,000. The present quarter, ending December 31, is expected to show sales of about $65,000,000. This amount will be a decrease of 12 per cent compared with the same quarter in 1923, but a gain of 12 per cent over the preceding quarter ended September 30.

Sales billed, however, are expected to be about $270,000,000 for the entire year, which would practically be the same as the previous year. This is accounted for by the fact that many orders for large equipment, such as turbines and generators, secured in 1923 were completed this year.

The Westinghouse Electric & Manufacturing Company has received an order from the W. S. Barstow Management Corporation, New York, for a 15,000-kw. turbine and frequency changer for the Broad River Power Company. It will cost about $400,000 and will be used at the new power station at Parr Shoals, near Spartanburg, S. C.

The Piedmont Electric Company, Asheville, N. C., electrical supply jobber, has received a contract from the towns of Mooresboro, Ellenboro and Boiling Springs, N. C., for the entire bill of material required for lighting and commercial distribution systems. A total of $30,000 has just been voted by these three towns which will be expended for these improvements.

The Heine Boiler Company, St. Louis, has appointed R. C. Broach Southeastern district manager, with offices at 709 Glenn Building, Atlanta. The territory will include eastern Tennessee, North and South Carolina, Alabama, Georgia and Florida. Mr. Broach, a native of Atlanta, has previously been employed in the general sales department of the Heine Boiler Company at St. Louis.

The Whiting Corporation, Harvey, Ill., manufacturer of cranes, foundry equipment, etc., announces the opening of a district sales office at 997 Ellicott Square Building, Buffalo. Hitherto it has had as agents George F. Crivel & Company of Buffalo. The new office is to be in charge of W. R. Hans, who has been in the employ of the company for many years.

New Equipment Available

Disconnecting Switch

An inclosed primary disconnecting switch for use in vaults ahead of the oil circuit breakers on circuits of 4,400 volts and under in capacities from 100 amp. to 400 amp. has been placed on the market by the Line Material Company, Milwaukee. The box is made of seasoned wood, painted inside and out with two coats of weatherproof paint, has dovetailed joints and is put together with screws. "Transite" barriers are used between switches. The door is hinged on both sides and can be padlocked if desired. A pull stick is mounted on the inside lower end of the door. Brown glazed porcelain bushings at top and bottom of the box provide for the wires, and the flexible contact clips are mounted on wet-process porcelain petticoat insulators which are securely bolted to a channel base, which is in turn bolted to a channel box to channel-wall straps extending each side of the box with holes for attaching to the wall. The box can be closed with the switches open.

Centrifugal Compressor

A new line of multistage centrifugal compressors, designed to supplement the line of single-stage machines recently developed, is now being marketed by the General Electric Company. These compressors have been especially developed for furnishing various volumes at higher pressures than are ordinarily obtained with single-stage machines. The main line of compressors covers water-cooled machines designed to deliver volumes of from 3,000 cu. ft. to 60,000 cu. ft. per minute, at pressures up to 30 lb. or more. The line will also include two types of miniature self-cooled machines designed to deliver volumes of from 250 cu.ft. to 1,400 cu.ft. per minute at pressures of from 2 lb. to 6 lb. All types are to be equipped with either motor or turbine drive.

Inductive Time-Limit Starter

An inductive time-limit starter to meet the requirements of uniform periods of acceleration of motors employed in driving auxiliary machines in steel mills has been developed by the Cutler-Hammer Manufacturing Company, Milwaukee. In this starter the inductive principle is utilized, dashpots and other mechanical and electro-mechanical means of timing the acceleration being dispensed with.

A transformer is used to provide a holding-out current of transient nature in successive accelerating switches. Transfer of connections takes place automatically with the cutting out of successive steps of resistance without disconnection of the coil circuit. Adjustments for the timing of the acceleration are made on the stationary parts and are permanent. The acceleration period is said to be uniform under ordinary conditions of load variations, the time being somewhat increased on heavy loads. There are no moving parts other than the reversing switches, main magnetic switches and accelerating switches. Two types of the starters are available, one for reversing table service and one for application where the motor is liable to stall, in which case a jamming relay is added.

Oil Motor Starter

A manually operated oil motor starter, known as type N-4, especially designed for industrial service and furnished for either two-phase or three-phase motors not exceeding 5 hp., has been placed on the market by the Condit Electrical Manufacturing Company, Boston. The entire starter is inclosed in a substantial metal case with a separate compartment for terminal connections and is arranged for thermal cut-outs where overload time-lag protection is desired. Fuse clips can also be furnished with this starter for operation on 250 volts or less. The starter is rated at 30 amp. and for operation on 600 volts or less.

CO_2 Recorder.—A new CO_2 recorder, known as the "Apex," which is less than half the price of the standard "Uehling" recorder made by the company, has been placed on the market by the Uehling Instrument Company, Paterson, N. J. The Apex CO_2 recorder employs no chemical solution, and there are no moving parts except the pen mechanism. The "Pyro-Porus" filter and the standard Uehling gas drier and desulphurizer are used. It is claimed that the recorder will operate accurately without any attention or adjustment other than the changing of charts an renewal of dry absorbent, which requires about ten minutes weekly.

Floodlight Projectors.—A new floodlight projector having a heat-resisting semaphore lens in the front door and a heat-resisting prismatic glass reflector on the inside of the rear door has been placed on the market by the Crouse-Hinds Company, Syracuse, N. Y. The casing and doors of the floodlight projector, known as type RCA or type RCE, according to the style of mounting, are made of cast iron and finished inside and out with baked-on black enamel. The focusing mechanism is made of cast brass. The projectors are designed to take 300-watt to 1,000-watt, 110-volt or 220-volt type C "Mazda" lamps. The adjustment of the beam of light, either vertically or horizontally, is made from the outside of the casing by turning two wing screws.

Electric Tube Furnace.—An electric tube furnace for heating small soldering irons and making tools and laboratory instruments and equipment has recently been placed on the market by the Westinghouse Electric & Manufacturing Company. The continuous safe operating temperature of the furnace is 1,600 deg. F., although a temperature of 1,850 deg. F. may be safely attained for short-time operation. If the furnace is equipped with a rheostat, pyrometers may be easily and quickly calibrated. A cord and plug attachment is supplied with the furnace for connection to an ordinary lamp socket.

New Trade Literature

WIRE FENCING.—The Page Steel & Wire Company, Bridgeport, Conn., has issued catalog No. 201, which is a reference book on wire fencing for the property owner. It describes the manufacture and metals used in wire fencing. It contains numerous illustrations showing electric plants, transformer stations, manufacturing works and institutions protected by the "Page" wire fences.

ELECTRIC FURNACE EQUIPMENT.—The Ajax Electrothermic Corporation, 636 East State Street, Trenton, N. J., is distributing a circular calling attention to the "Ajax" high-frequency electric furnace equipment.

POWER TRANSFORMERS. — Bulletin No. 140, issued by the Wagner Electric Corporation, St. Louis, describes the "Wagner" oil-filled, self-cooled transformers. It also contains an article giving an outline of the great development in power transmission and the use of high-voltage transmission in connection with transmission lines and alternating-current motors for utilizing the power.

INSULATION. — "Micabond the Modern Mica" is the title of a booklet issued by the Chicago Mica Company, Valparaiso, Ind., which contains a brief history of electrical insulation, a description of the manufacture of "Micabond" and gives practical tests for mica insulation, etc.

STREET LIGHTING. — "Better Street Lighting with Union Metal Lamp Standards and General Electric Lighting Units" is the title of a booklet issued by the Union Metal Manufacturing Company, Canton, Ohio. It contains a complete line of ornamental standards and brackets for the lighting of business districts, residential streets, parks and highways.

WIRING DEVICES.—The Bryant Electric Company, 1421 State Street, Bridgeport, Conn., has issued its 1924 catalog, which contains listings and descriptions of more than 5,000 wiring devices. It is published in three styles: "A," loose-leaf, 8½ in. x 10 in., for use by jobbers and large dealers who wish to keep the catalog up to date; "C," 7½ in. x 10½ in., and a small edition for pocket use.

FLEXIBLE COUPLINGS.—Bulletin L-18 issued by the Foote Brothers Gear & Machine Company, 215 North Curtis Street, Chicago, describes and illustrates the various types of flexible couplings manufactured by the company.

STEAM TURBINE.—A publication issued by the De Laval Steam Turbine Company, Trenton, N. J., describes an improved steam turbine specially designed for use with high-pressure, high-temperature steam. The turbine is of the impulse-velocity stage type, so that the wheel case contains steam at exhaust pressure and temperature only. It is built in capacities from 1 hp. to 800 hp. and is designed primarily for non-condensing service.

MANOMETERS.—The Bacharach Industrial Instrument Company, 7,000 Bennett Street, Pittsburgh, has issued bulletin No. 130 in Sections 1 and 2, covering the various types of the "Bacharach" manometers.

INSULATION MEASUREMENT. — Bulletin No. 128, entitled "What Constitutes Safe Insulation," issued by Herman H. Sticht & Company, 15 Park Row, New York City, calls attention to insulation resistance and the value of insulation measurements.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Bahia, Brazil (No. 12,200), for electrical supplies.

An agency is desired in Montreal, Canada (No. 12,207), for electrical supplies.

Purchase is desired in Vancouver, Canada (No. 12,262), of radio sets and parts.

Purchase is desired in Dargaville, New Zealand (No. 12,214), of radio sets and parts.

VOLTAGE REGULATING APPARATUS, SWITCHGEAR AND ACCESSORIES FOR THE YALLOURN (AUSTRALIA) POWER SCHEME.—Tenders will be received by the State Electricity Commission of Victoria, Melbourne, Australia, until Dec. 20 for switchgear and accessories (Specification No. 24/114) for the Yallourn power scheme. Tenders will also be received by the State Electricity Commission of Victoria, Melbourne, until Jan. 19, 1925, for voltage-regulating apparatus (Specification No. 25/2), for the Yallourn power scheme. Copies of tender form and specifications may be obtained on application to the offices of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, 734 Custom House, New York City, and First National Bank Building, Chicago.

New Incorporations

THE SOUTHERN POWER & LIGHT COMPANY, Oklahoma City, Okla., has been incorporated with a capital stock of $250,000 by J. F. Owens, W. R. Emerson, 1216 West Twentieth Street, and Streeter B. Flynn.

THE MACY GROVE ELECTRIC LIGHT COMPANY, Kernersville, N. C., has been chartered with a capital stock of $20,000 by L. B. Stanley, C. F. Snow and E. C. Atkins.

THE CITIES SERVICE POWER & LIGHT COMPANY, New York City, has been organized to take over the electric light and power properties of the Cities Service Company. The company will have an authorized capitalization of $100,000,000. Henry L. Doherty is president of the company.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MALDEN, MASS.—The extension of the ornamental lighting system on Salem Street from Converse Square to Linden Street is under consideration by the City Council.

REVERE, MASS.—The installation of a new lighting system for Revere Beach is reported to be under consideration by the Metropolitan District Commission.

WORCESTER, MASS.—Plans are being prepared by L. W. Briggs, 316 Main Street, for a fire-alarm telephone building, Newton Hill, to cost about $150,000, for the Fire Department.

WORCESTER, MASS.—The question of extending the ornamental lighting system on Grafton Street from Carolina Street to Rice Square is under consideration by the City Council.

Middle Atlantic States

ALBANY, N. Y.—The extension of the new ornamental lighting system on Broadway to Catherine Street is under consideration by the Board of Aldermen.

BROOKLYN, N. Y.—The Brooklyn Edison Company, Inc., which recently acquired the electric plant of the Flatbush Gas Company, is planning to build a 40,000-hp. substation and will change all wiring to the three-phase, four-wire system in the service territory of the Flatbush Gas Company. The cost of the entire work is estimated at about $1,000,000.

ITHACA, N. Y.—The New York Central Electric Corporation has petitioned the Public Service Commission for approval of franchises granted by the towns of Erwin and Sparta and the villages of Bath and Hammondsport.

JAMESTOWN, N. Y.—The Western New York Electric Company has petitioned the Public Service Commission for authority to acquire all the property of the Carroll Electric Light & Power Company, Warren, Pa., which distributes electricity in the towns of Carroll and Kiantone.

NEW YORK, N. Y.—The New York Edison Company will soon take bids for the construction of a distributing station at 215-17 East Ninety-fourth Street. William Whitehill, 709 Sixth Avenue, is architect.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has applied to the Public Service Commission for approval of franchises granted by the village of Port Leyden and the town of Leyden and for permission to erect service lines.

HACKENSACK, N. J.—A movement has been started by the Business Men's Association to secure an ornamental lighting system for Main Street.

TRENTON, N. J.—Bids will be received by the Board of Commissioners, Municipal Building, until Nov. 28 for construction of sewage-treatment works, including installation of pumps, motors, generators, outfall line, water and other miscellaneous piping, etc. George A. Johnson and George L. Watson, 150 Nassau Street, New York City, are engineers. A. C. Gregory, Municipal Building, is engineer of sewers.

PITTSBURGH, PA.—The city officials are negotiating with the Duquesne Light Company with a view to securing a better street-lighting system, with no increased cost to the city.

SHARON, PA.—The City Council is considering the installation of a new lighting system on North Water, Ormond Avenue, Buhl Drive and a number of other streets, to cost about $15,000.

TYRONE, PA.—The Penn Central Light & Power Company, Altoona, which recently acquired the local plant, plans to extend its transmission line here for local light and power service. The company will also furnish service at Bellwood, Warriors Mark and vicinity.

ACCIDENT, MD. — The Youghiogheny Hydro-Electric Corporation, Baltimore, plans to construct a local power substation for distribution in this district. A site has been acquired and permission secured from the city.

BALTIMORE, MD.—Bonds to the amount of $1,500,000 have been voted for extension to the conduit system for electric wires.

BALTIMORE, MD.—The Department of Lamps and Lighting plans to construct underground conduit systems on Cathedral and Charles Streets and also to install an improved street-lighting system on portions of the same thoroughfares and also on North Avenue, Monroe and St. Paul Streets. William A. Parr is superintendent.

FRIENDSVILLE, MD. — The power house, generators and boilers at the coal mines of John W. McCullough were recently destroyed by fire.

AMHERST, VA.—Bonds to the amount of $75,000 have been voted for the construction of a municipal electric light plant and waterworks system.

DANVILLE, VA.—Plans are under consideration by the city officials for extension to the ornamental street lighting in the business district.

WASHINGTON, D. C.—Plans are under consideration by the Board of District Commissioners for the installation of an improved street-lighting system on a portion of Pennsylvania Avenue. Warren B. Hadley is electrical engineer.

WASHINGTON, D. C.—Bids will be received by the Post Office Department until Nov. 26 for 25,000 ft. of armored cable.

North Central States

DETROIT, MICH.—The Detroit Edison Company is preparing plans for the construction of an equipment storage and distributing station on Fenkell Street, near La Salle Street, to cost about $175,000.

IRON MOUNTAIN, MICH. — The Iron Mountain Electric Light & Power Company is considering the construction of a substation in Kingsford. Improvements to the local electric plant, to cost about $5,000, are also contemplated.

CLEVELAND, OHIO. — The Cleveland Railway Company is planning to build a substation on Central Avenue, to cost about $65,000.

CLEVELAND, OHIO.—To supply electricity to the coal and iron cities of the Middle West between Lake Erie and the Ohio River, a distance of 400 miles, a new steam-driven electric generating station, to cost ultimately $30,000,000, at Avon on Lake Erie, near Cleveland, will be built by the Cleveland Electric Illuminating Company. The initial installation will have a capacity of 90,000 hp., and will be tied in with the Lake Shore plant of the Cleveland company. The plans call for an ultimate development of 400,000 hp. The new plant will be equipped to burn pulverized coal.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until Nov. 28 for steam boilers and superheaters for the division of light and power.

LEXINGTON, KY. — Application has been made by M. Webb Offut, W. J. Loughridge, R. T. Gunn and W. A. Hifner, Jr., 205 First and City National Bank Building, Lexington, to the Federal Power Commission for a preliminary permit for a hydro-electric development on the North Fork of the Kentucky River in Lee, Breathitt, Wolfe, Perry, Letcher, Leslie and Knott Counties. The project includes the construction of an 85-ft. concrete dam near Airdale, above the mouth of the Middle Fork, to develop 20,000 hp.

MADISONVILLE, KY.—The installation of an ornamental lighting system in the business district, to cost about $10,000, is under consideration by the City Council.

GARY, IND.—The Illinois Steel Corporation plans extensions in its local electric power plant, to include the installation of two 15,000-kw. steam-turbine generators, boilers, stokers, etc.

INDIANAPOLIS, IND.—The Indianapolis Light & Heat Company plans extensions in its steam-operated electric plant on Kentucky Avenue.

INDIANAPOLIS, IND. — The Public Service Commission has approved the contract of the Merchants' Heat & Light Company for furnishing street lighting in the city for a period of ten years.

OAKDALE, IND.—The Indiana Hydro-Electric Power Company, Norway, will soon start on the construction of the second unit of its hydro-electric power development on the Tippecanoe River, at Oakdale, to develop 13,000 hp. The cost is estimated at $1,000,000.

LA SALLE, ILL.—Plans for the proposed local cement mill of the Red Star Cement Company, 140 South Dearborn Street, Chicago, to cost about $2,000,000, include a power house.

KOHLER, WIS. — Plans have been adopted by the Village Board for extending the ornamental lighting system into the new section of the village.

LIVINGSTON, WIS.—The Village Board has approved the proposition submitted by the Wisconsin Power & Light Company, Madison, to install and maintain an ornamental lighting system in the business section of the city.

OCONTO, WIS.—The Northeastern Power Company, Oconto, is considering the construction of a transmission line from Kaukauna to furnish power to the Wisconsin Public Service Corporation.

PARDEEVILLE, WIS.—The State Railroad Commission has directed the Pardeeville Electric Light Company to reconstruct its transmission lines now supplying electric service to consumers in the outlying districts.

SUPERIOR, WIS.—The City Council has rejected all bids submitted for an ornamental lighting system on Belknap Street, between Tower and Week Avenues. New bids will be called for soon.

WAUSAU, WIS.—The Wisconsin Valley Electric Company is considering extending its transmission line from Plover to Arnott, a distance of 8 miles.

MILACA, MINN.—The Eastern Minnesota Power Company contemplates the erection of a high-tension transmission line between Milaca and Onamia.

MINNEAPOLIS, MINN.—The installation of ornamental lamps on Washington Avenue and Lake Street bridges is under consideration by the City Council.

ST. CLOUD, MINN. — The Northern States Power Company, Minneapolis, contemplates the erection of a high-tension line from St. Cloud to St. Joseph, to cost about $300,000.

CLERMONT, IOWA.—The Northeastern Iowa Power Company, is considering the construction of a hydro-electric power plant on the Shell Rock River. The company has recently acquired the Green (Iowa) Electric Light & Power Company and the Dunkerton (Iowa) Light & Power Company and will consolidate the properties.

DAVENPORT, IOWA. — Plans for the proposed cement mill of the Linwood Cement Company, Kahl Building, to be located about 8 miles from the city, include a power house. The entire cost is estimated at $1,200,000. The J. C. Buckbee Company, 38 South Dearborn Street, Chicago, is engineer.

IOWA FALLS, IOWA.—The Iowa Falls Electric Company has taken an option on the old grist-mill and the water-power rights on the Iowa River, with a view of building a hydro-electric power plant, to cost about $150,000.

APPLETON, MO.—The City Council contemplates the construction of a municipal waterworks system, to cost about $100,000. The plans include electrically operated pumping equipment.

BLOOMFIELD, MO. — The Bloomfield Electric Light, Heat, Power & Water Company, which was recently granted a new franchise by the Council, is planning extensions in its system.

JOPLIN, MO.—Tentative plans are under consideration by the Empire District Electric Company for a hydro-electric power development on the White River, near Hollister. The project includes a power dam, 175 ft. high and 2,500 ft. long. The initial installation will have an output of about 30,000 hp. The cost is estimated at $12,000,000.

SHELBYVILLE, MO. — The Missouri Power & Light Company, Mexico, has authorized the erection of a transmission line from Clarence to Shelbyville.

COOPERSTOWN, N. D.—The Cooperstown Light & Power Company plans to rebuild its power plant, recently damaged by fire.

BLOOMINGTON, NEB.—The Council is considering the erection of a transmission line to Alma, to secure electricity for the local municipal electric system.

BRIDGEPORT, NEB.—The City Council is having preliminary plans prepared for a municipal electric plant and distributing system. The Henningson Engineering Company, National Bank Building, Omaha, is engineer.

Southern States

ROSEBORO, N. C. — The City Council contemplates the installation of electrically operated pumping equipment, in connection with waterworks, to cost about $85,000.

ROCK HILL, S. C.—The City Council has entered into a contract with the Southern Power Company, Charlotte, N. C., to furnish electricity to the city for a period of five years.

COLUMBUS, GA.—The directors of the Columbus Electric & Power Company have authorized the construction of a hydro-electric plant of 40,000 hp. capacity at Bartlett's Ferry on the Chattahoochee River, at an initial cost of $7,300,000. The erection of a 35-mile transmission line from Bartlett's Ferry to Manchester, to cost about $500,000, has also been approved.

BOYNTON, FLA.—The Board of City Commissioners is planning extensions in the street-lighting system.

LAKE CITY, FLA.—The City Council has arranged for a bond issue of $16,000 for extensions in the municipal light and power plant.

MIAMI, FLA.—The Miami Electric Light & Power Company is considering the construction of three suburban electric substations, to be located at Little River, Buena Vista and Cocoanut Grove. The cost is estimated at $75,000. Contract for equipment, it is understood, has been awarded.

BIRMINGHAM, ALA.—The Public Service Commission has granted the Alabama Power Company permission to extend the Bellevue high-tension transmission line from Oakman into Fayette, Bankston and Berry, a distance of 26 miles. Distribution systems will be erected at Bankston and Berry. The commission has also approved the sale of the electric system in Fayette and the electric distribution system in Bellevue Highlands to the Alabama company.

ARKWRIGHT, ARK.—The International Agricultural Corporation, Atlanta, Ga., plans to install considerable electric power equipment in its local fertilizer works, to cost about $125,000.

WETUMKA, OKLA. — Bonds to the amount of $61,000 have been voted for improvements to the municipal electric plant, to include the installation of a 400-hp. Diesel engine-driven generating unit, switchboard, transmission lines, rebuilding electric distribution system and installing an ornamental lighting system, etc. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

BEAUMONT, TEX.—The installation of an ornamental lighting system on Orleans Street, to cost about $17,000, is under consideration by the City Commissioners.

BRENHAM, TEX.—The sale of the electric light and power plant of the Brenham Compress Oil & Manufacturing Company to the Texas Public Utilities Company, a subsidiary of the Texas Power & Light Company, Dallas, is accompanied by the announcement that an extensive transmission system is to be built in this part of the state by the company. It is proposed to cover all the territory between Houston and Austin, 185 miles, with Brenham as the probable site for the main power station.

DEVINE, TEX.—The plant of the Devine Electric & Ice Company has been acquired by the Texas Central Power Company, Chemical Building, St. Louis.

HOUSTON, TEX.—The Tennant Company, engineer, is planning for the purchase of a steam-engine generator set (about 150 kw.), for a local installation.

KENEDY, TEX.—The plant and system of the Kenedy Ice & Power Company has been acquired by the Texas Central Power Company, Chemical Building, St. Louis.

PADUCAH, TEX.—Plans for the proposed new waterworks, to cost about $100,000, include electrically operated pumping equipment. Gantt-Baker Company, Oklahoma City, Okla., are engineers.

Pacific and Mountain States

SULTAN, WASH.—The Sultan Electric Company has applied to the State Supervisor of Hydraulics for additional water rights on Tomtit Lake, Roeniger Lake and McCoy Creek, in Snohomish County. If the application is granted, the company plans extensions to its present plant.

BAKER, ORE.—The Eastern Oregon Light & Power Company has filed application with the State Engineer covering the appropriation of water from the Grande Ronde River in Wallowa County for a hydro-electric development. The cost of the project is estimated at $550,000.

ANAHEIM, CAL.—At a special election held recently the proposal to issue $240,000 in bonds for the construction of a municipal electric light and power plant was defeated.

LONG BEACH, CAL.—A committee has been appointed by the City Council to make investigations regarding the feasibility of installing a municipal electric plant.

LOS ANGELES, CAL.—The City Council has authorized plans for the installation of ornamental lamps on the following streets: Sixteenth Street, comprising 52 concrete standards; on Main Street, 159 pressed-steel standards; Mullen Avenue, 21 concrete standards; Orange Drive, 27 pressed-steel standards; Broadway, 31 pressed-steel standards, and Eighth Street, 197 pressed-steel standards.

OAKLAND, CAL.—Plans are under way by the Pacific Gas & Electric Company, San Francisco, for the installation of new equipment, to include a 2,500-hp. steam condenser, 20-in. salt water pipes, etc., to cost about $35,500, in its local plant.

RED BLUFF, CAL.—Preliminary plans are being prepared by the Pacific Gas & Electric Company, San Francisco, for the erection of a local outdoor substation, to cost about $55,000.

SAN GABRIEL, CAL.—The Board of City Trustees has authorized the installation of an ornamental lighting system on Shore Road, from Hermosa Drive to Las Lunas Drive.

SAN MATEO, CAL.—The City Council has authorized plans for the installation of an ornamental lighting system on Third Avenue, comprising twenty-two standards.

STOCKTON, CAL. — The City Council plans the installation of an automatic fire-alarm system. W. B. Hogan is city engineer.

WALNUT CREEK, CAL.—The Pacific Gas & Electric Company, San Francisco, plans to build a substation in Walnut Creek in the Mount Diablo Park district. The work includes the erection of 15 miles of high-tension transmission line, building of substation and moving another substation. The total cost is estimated at about $51,000.

MONROE, UTAH.—The construction of another power plant in Main Canyon, to cost $25,000, is under consideration by the City Council.

Canada

VANCOUVER, B. C.—The construction of a cold-storage plant, to cost about $500,000, is under consideration by the Vancouver Harbor Commissioners. W. G. Swan, 525 Seymour Street, is engineer.

MOOSE JAW, SASK.—A by-law to appropriate $150,000 for the installation of a new electric generating unit in the municipal electric plant will be submitted to the rate payers at an election to be held Dec. 8.

Electrical Patents

Announced by U. S. Patent Office

(Issued October 21, 1924)

1,512,221. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; Frank A. Haughton, Schenectady, N. Y. App. filed March 5, 1924. Method of holding clamping rings.

1,512,235. ELECTRIC SWITCH; Charles L. Perry, Schenectady, N. Y. App. filed Jan. 21, 1921. Of the air-break clapper type.

1,512,244. ELECTRIC SWITCH; John W. Simmons and Robert P. Simmons, Cleveland, Ohio. App. filed Sept. 28, 1921. Using a pivoted lever to operate.

1,512,251. PROTECTIVE SYSTEM; Henry Trencham, Ruislip, England. App. filed Jan. 16, 1922. Of the pilot-wire type.

1,512,255. SYSTEM OF ELECTRIC DISTRIBUTION; Frank P. Whitaker, Rugby, England. App. filed Nov. 19, 1923. Direct-current network.

1,512,285. OZONE GENERATOR; Harry B. Hartman, Scottdale, Pa. App. filed March 2, 1923.

1,512,289. ELECTRIC HEATER; Donald H. McCorkle, Berkeley, Cal. App. filed Dec. 10, 1923. Portable or fireplace type.

1,512,293. SYSTEM OF TELEPHONY AND TELEGRAPHY; William W. McLaren, Birmingham, Ala. App. filed Aug. 5, 1922. Over submarine cables.

1,512,313. STORAGE-BATTERY CONTAINER; James G. Rowe, Niagara Falls, N. Y. App. filed Dec. 28, 1923. Molded type.

1,512,344. MAGNETIC SEPARATOR; Paul Lorang, Metz, France. App. filed March 28, 1923.

1,512,359. ELECTRICAL SOLDERING IRON; Arthur B. Nelson, Aberdeen, S. D. App. filed Feb. 3, 1922.

1,512,361. METHOD FOR SYNCHRONIZING APPARATUS ON A LONG DISTANCE; Hermod M. Petersen, Christiania, Norway. App. filed June 18, 1920. As telegraph apparatus.

1,512,366. ELECTRIC HEATING DEVICE; Thomas C. Russell, Chicago, Ill. App. filed April 7, 1922. For use with flatirons, etc.

1,512,385. FLUID-PRESSURE INDICATOR; Herbert C. Widlake, Plymouth, England. App. filed March 8, 1921.

1,512,387. LIGHTNING ARRESTER; Rudolf Wolf, New York, N. Y., and Henry G. Pierson, South Orange, N. J. App. filed May 10, 1920. For telegraph wires and the like.

1,512,398. AIR CONDENSER; Ralph C. Browne, Salem, Mass. App. filed Oct. 14, 1922. As used in radio apparatus.

1,512,405. ELECTRIC WATER-HEATING SYSTEM; Androv H. Carlson, Bridgeport, Conn. App. filed Jan. 7, 1922. Instantaneous.

1,512,443, 1,512,444. CABLE INSTALLATION; Ralph W. Atkinson, Perth Amboy, N. J. App. filed May 18, 1923. For single-conductor high-voltage cables; to overcome induction in lead sheath.

1,512,457. CONDUCTOR SUPPORT; Homer P. Chandler, Mansfield, Ohio. App. filed Sept. 26, 1923. For the adjacent ends of two trolley sections.

1,512,467, 1,512,468. FLASHLIGHT; Gustaf I. Johnson, Malden, Mass. App. filed May 11, 1922. With spring-actuated generator.

1,512,482. ELECTRIC COOKER; Ralph J. Patterson, Watertown, Mass. App. filed Oct. 17, 1923. With a baffle situated above the heating element in such a manner that a closed circulation of air is established.

1,512,485. ELECTRIC ACCUMULATOR; Adolfo Pouchain, Turin, Italy. App. filed April 18, 1921. Negative plates consisting wholly or partly of zinc as active material.

1,512,517. JACKET HEATER FOR INTERNAL-COMBUSTION ENGINES; John Astrom, Fort Wayne, Ind. App. filed Jan. 27, 1922.

1,512,534. SHORT-CIRCUITING DEVICE FOR ALTERNATING-CURRENT MOTORS; J. Lee Hadley and Herman G. Reibel, Warren, Ohio. App. filed March 28, 1921. As used for repulsion starting of induction motors.

1,512,574. CONTROL SYSTEM FOR MACHINE TOOLS; Harold L. Blood, North Plainfield, N. J. App. filed Oct. 7, 1921.

1,512,575. PLANER CONTROL SYSTEM; Harold L. Blood, North Plainfield, N. J. App. filed Oct. 7, 1921. Automatic control.

1,512,584. TELEPHONE-EXCHANGE SYSTEM; Bert G. Dunham, Hawthorne, N. J. App. filed May 20, 1919. Having a special switch for extending a calling line.

1,512,594. SHORT-CIRCUIT-PROOF SOCKET; Stephen S. Grady, Newtonville, Mass. App. filed Dec. 13, 1921.

1,512,674. COOKING MACHINE; Henry A. Campbell, Oakland, Cal. App. filed Nov. 21, 1923. Automatic.

1,512,693. INDUCTION MOTOR; Ernest Juillard, Geneva, Switzerland. App. filed Oct. 18, 1922. Suitable for conditions detrimental to insulation; conductors freely supported in the core slots.

1,512,705. FLASHLIGHT OPERA GLASS; Isidore Margaretten and Morris Greenman, New York, N. Y. App. filed Jan. 26, 1923. Combination opera glass and flashlight.

1,512,719. TELEPHONE SYSTEM; John C. Stiles, St. Louis, Mo. App. filed April 28, 1921. May be applied to party lines.

1,512,786. WELDING ELECTRODE; Harry D. Morton, New York, N. Y. App. filed Jan. 22, 1924. For metallic arc welding.

1,512,787. MEANS AND METHOD OF EFFECTING CONTINUOUS ELECTRIC ARC WELDS; Harry D. Morton, New York, N. Y. App. filed Feb. 5, 1924.

1,512,788, 1,512,789. ELECTRIC ARC WELDING APPARATUS AND METHOD OF OPERATING THE SAME; Harry D. Morton, New York, N. Y. App. filed Feb. 5, 1924.

1,512,815. ELECTRICAL RECEPTACLE AND PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 8, 1920. Heavy-duty watertight type.

1,512,816. ELECTRICAL FIXTURE-SUPPORTING DEVICE; Reuben B. Benjamin, Chicago, Ill. App. filed July 5, 1921. "Elexit" type.

1,512,824. WIRELESS TELEGRAPH AND TELEPHONE RECEIVER; Henri de R. de Bellescize, Paris, France. App. filed Aug. 29, 1921. Protected from damped statics or strays.

1,512,890. AUTOMATIC LOAD-CONTROL DEVICE FOR ELECTRIC MOTORS; Clarence M. Holley and Earl P. Oswald, Detroit, Mich. App. filed Oct. 23, 1919. Will permit the motor to start independently of the load.

(Issued October 28, 1924)

1,512,907. TELEPHONE SYSTEM; Roy D. Conway, Chatham, N. J. App. filed Dec. 29, 1919. For signaling over transmission lines.

1,512,923. INCANDESCENT ELECTRIC LIGHTING; C. A. B. Halvorson, Jr., Lynn, Mass. App. filed Oct. 31, 1921. Supporting socket.

1,512,930. SIGNALING SYSTEM; Harry W. Hitchcock, New York, N. Y. App. filed Oct. 20, 1921. Method and means for constructing a cable from a plurality of sections to minimize the effect upon transmission of signals caused by irregularities in the impedance of the various sections.

1,512,933. SIGNALING SYSTEM; Philip Husta, Corona, N. Y. App. filed Sept. 7, 1921. For telephone.

1,512,941. FREQUENCY-CHANGING DEVICE; Siegmund Loewe, Berlin, Germany. App. filed March 19, 1921. Using electron-discharge tubes.

1,512,944. CONDUCTOR HOLDER; John A. Ness and Walter Ness, Montevideo, Minn. App. filed March 2, 1921. For telegraph and telephone line wires.

1,512,953. ARRANGEMENT FOR PROTECTING ELECTRICAL CONTACTS; Roy B. Shanck, Woodside, N. Y. Against sparking and the attendant pitting.

1,512,960. RADIO SIGNALING SYSTEM; Julius Weinberger, New York, N. Y. App. filed Oct. 11, 1921. Method and arrangement for controlling the amplitude of high-frequency signaling currents.

1,512,968. AUTOMATIC ELECTRIC COUPLER; Harry F. Woernley, Wilkinsburg, Pa. App. filed Nov. 13, 1920. For connecting electric circuits between the cars of a train.

1,512,969. MEANS FOR CONTROLLING THE ACTIVITY OF WORK-PERFORMING CIRCUITS; Frank W. Wood, Montclair, N. J., and Paul Grierson, South Orange, N. J. App. filed March 15, 1919. Where it is desirable that work be performed at definite intervals.

1,512,982. DRY-BATTERY CARRIER AND TESTER; John Graves, Madison, Wis. App. filed Sept. 25, 1919.

1,512,984. RHEOSTAT; Foster F. Hillix, Cleveland, Ohio. App. filed March 10, 1922. For small motors such as sewing-machine motors.

1,512,997. LEADING-IN CONNECTOR FOR AËRIAL WIRES AND THE LIKE; Charles V. Morris, Davenport, Stockport, England. App. filed Feb. 21, 1924. For wireless receiving apparatus.

1,513,010. ARRANGEMENT FOR PRODUCING ELECTRICAL OSCILLATIONS; Hand Rukop, Berlin, Germany. App. filed May 3, 1922. By means of electron-discharge tubes provided with a space-charging grid.

1,513,058. CURRENT COLLECTOR; Samuel S. Matthes, Mansfield, Ohio. App. filed March 1, 1922. For trackless trolley.

1,513,069. TELEPHONE-RECEIVER-HOOK-LIFTING DEVICE; Robert Reinbold, St. Paul, Minn. App. filed June 24, 1922.

1,513,071. ELECTRICAL TACHOMETER; Herbert O. Russell, Detroit, Mich. App. filed March 9, 1922.

1,513,076. SYSTEM FOR LOCATING BREAKS IN ELECTRIC POWER LINES; Felix Visintainer, Glacier, Wash. App. filed Feb. 11, 1922. Where the break includes all of the conductors.

1,513,140. SIGNALING DEVICE; William L. Walker, New York, N. Y. App. filed Oct. 25, 1920. For submarine signaling.

1,513,171. TELEPHONE SYSTEM; John E. Hilbish, La Grange, Ill. App. filed June 20, 1921. Cord circuits provided with automatic ringing and listening, secret service and instantaneous disconnect and recall.

1,513,206. DISK-TYPE INSULATOR; Christian Aalborg, Wilkinsburg, Pa. App. filed Nov. 13, 1919. Strain insulator.

1,513,211. FLASHLIGHT; Edmund R. Barany, Brooklyn, N. Y. App. filed August 14, 1922. With adjustable reflector.

1,513,223. RECEIVING CIRCUIT FOR THE ELIMINATION OF STATIC DISTURBANCES; Frank Conrad, Pittsburgh, Pa. App. filed Oct. 17, 1918.

1,513,224. MEANS FOR MINIMIZING INDUCTIVE DISTURBANCES; Almon W. Copley, Wilkinsburg, Pa. App. filed Aug. 9, 1916. For protection of intelligence-transmission circuits.

1,513,232. MEASURING SYSTEM; Robert D. Evans, Wilkinsburg, Pa. App. filed Nov. 3, 1917. Methods of summing the amount of energy supplied to a circuit at a plurality of widely separated points.

1,513,239. PROCESS OF MOUNTING RESISTANCE ELEMENTS OF ELECTRIC HEATERS; Johann Gyuris, Budapest, Hungary. App. filed April 7, 1921.

1,513,240. THERMOSTATIC SWITCH; Leonard D. Hammon, Bay of Plenty, New Zealand and David W. McGill and Harold B. Irvine, Christchurch, New Zealand. App. filed June 6, 1922. For sadiron, etc.

1,513,242. ELECTRICAL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed June 18, 1919. Constant-voltage systems for train lighting.

1,513,250. METHOD OF GENERATING AND CONTROLLING THE GENERATION OF STEAM; Frederick T. Kaelin, Montreal, Quebec, Canada. App. filed Jan. 31, 1922. By direct action of electric current on water.

1,513,286. STATIC ELIMINATION SYSTEM; Joseph Slepian, Swissvale, Pa. App. filed Nov. 16, 1921. For wireless receiving systems.

1,513,291. INSULATOR; Louis Steinberger, Brooklyn, N. Y. App. filed Jan. 17, 1918. Compression type; body and strain members readily assembled and disassembled.

1,513,292. COLUMN-STRAIN INSULATOR; Louis Steinberger, Brooklyn, N. Y. App. filed June 12, 1919. With a plurality of electrical stress distributors.

1,513,293. STRAIN INSULATOR; Louis Steinberger, Brooklyn, N. Y. App. filed April 3, 1920. Body portion detachable from the strain members.

1,513,299. ELECTROMAGNETICALLY OPERATED SWITCH GEAR; Emil Volkers, Berlin-Lankwitz, Germany. App. filed June 30, 1924.

1,513,303. ELECTRIC MOTOR; Edward M. Waring, Brooklyn, N. Y. App. filed May 26, 1916. Capable of being made in relatively small sizes.

1,513,324. POLYPHASE PLATE-CIRCUIT-EXCITATION SYSTEM; Samuel M. Kintner, Pittsburgh, Pa. App. filed Oct. 25, 1921. For electron-discharge tubes.

1,513,326. RADIO DETECTOR; Wilbur C. Lamphier, New York, N. Y. App. filed Feb. 9, 1923. Crystal type.

1,513,337. MEANS FOR ELECTRICALLY DRIVING THE BOWLS OF CENTRIFUGAL SEPARATORS; Alfred Melotte, Remicourt, Belgium. App. filed Sept. 9, 1920.

1,513,340. BUSBAR STRUCTURE; Douglas F. Miner, Wilkinsburg, Pa. App. filed Sept. 24, 1920. For parallel inductively related conductors.

1,513,351. MEASURED-SERVICE TELEPHONE SYSTEM; Dawson M. Taggart, Lancaster, Pa., and Frederick J. Scudder, Long Island City, N. Y. App. filed Dec. 16, 1920.

1,513,355. INTERCHANGEABLE ELECTRICAL CONNECTION FOR CARBON BRUSHES; Richard H. Ward, Queens, N. Y. App. filed Jan. 17, 1923.

1,513,362. TELEPHONE-EXCHANGE SYSTEM; Louis M. Allen, New York, N. Y. App. filed Sept. 22, 1921. Mechanical switching.

1,513,393. ELECTRIC SOCKET-SUPPORTING STRUCTURE; Max Herskovitz, Chicago, Ill. App. filed Feb. 21, 1921. For use as in table or floor lamps.

1,513,405. ARMATURE CONSTRUCTION FOR DYNAMO-ELECTRIC MACHINE AND PROCESS OF PRODUCING THE SAME; Albion D. T. Libby, East Orange, N. J. App. filed October 30, 1920. Molded support for end turns.

Financial and Corporate

Utility Prices Irregular

Market Again Shows Mixture of Gains and Losses in Week of Fair Trading

ACTIVITY in the railroad securities diverted attention away from the power and light securities during the past week, but to a less extent than immediately following election. Even the utility stocks listed on the big board with the rails, such as American Water Works & Electric Company's common and North American Company's common, improved materially in position on more active trading. The former ran up to 120 again and the latter established a new high in crossing 36.

The unlisted market in utility stocks closed the week with a mixture of advances and declines but with an improving tone. Interest appeared to be turning afresh to the power and light list. American Gas & Electric Company's stock had an impressive rise to a level above par for the first time, after selling as low as 48 earlier in the year. This advance, which was, perhaps, the feature of broadest interest, was accompanied by rumors of various descriptions not as yet borne out by official announcements. The stock's gain for the week was five points.

Continued improvement in Alabama Traction, Light & Power Company's stock and in the new Southeastern Power & Light Company's stock, which is being exchanged for Alabama, drove both issues into fresh high territory. Alabama Traction sold at 80 and Southeastern at 40. Buying of these issues has been in enormous volume, and the rise has had little interruption. Dividends for the new Southeastern stock are predicted in utility circles for next year, although here again the thing still is a matter of rumor. However, the Alabama Traction bonds have been active with the stock, and the coupon rate of the bonds must be increased by 1 per cent prior to the inauguration of dividends. Western Power was stronger.

Issues that lost ground during the week were Cities Service, Lehigh Power, National Power & Light and Tennessee Electric Power.

New Capital Issues

The largest individual flotation of public utility bonds during the week ended November 18 was the issue offered by the Cleveland Electric Illuminating Company, amounting to $11,500,000 in general mortgage 5 per cent gold bonds, series A. The total amount of this series of bonds will be limited to $30,000,000, $18,500,000 of which will be reserved to issue for refunding purposes. The proceeds from the present loan will be used for betterments and extensions to the company's system.

Besides the bond issue, rights are being offered to subscribe to $5,281,700 additional preferred stock and $1,584,500 additional common stock. Holders of the 6 per cent preferred stock, authorized 1892 and 1897, and of the common stock at the close of business November 24, 1924, will be entitled to subscribe for one share of 6 per cent, series 1923, preferred stock at $100 for each of three shares held, and will also be entitled to subscribe for one share of common stock at $150 per share for each ten shares held. Issuance of these securities is subject to the approval of the Public Utilities Commission of Ohio. The Cleveland company is the second important utility company to offer common stock at a premium within a few months, the Edison Electric Illuminating Company of Boston having offered stockholders' rights to subscribe to additional stock at $155 per share in September, 1924.

The Central Iowa Power & Light Company's offering of $6,500,000 first mortgage 6 per cent bonds of 1944, which were retailed at par, was the only other large piece of public utility financing. These obligations are a direct first mortgage on the properties to be consolidated under the name of the Central Iowa Power & Light Company, but which heretofore have been owned and operated by three companies, (1) the Citizens' Gas & Electric Company, (2) Cedar Valley Electric Company and (3) Northern Iowa Gas & Electric Company. In order to set up a direct first mortgage against the operating properties and facilitate future financing, obligations of the consolidated companies are being retired. The new company, Central Iowa Power & Light Company, will, as were its predecessors, be under the control of the American Gas Company. The Broad River Power Company, organized last July in South Carolina, was represented in the week's activities with an issue of 7 per cent cumulative preferred stock, totaling $1,250,000.

Tennessee Electric Power Company

This Comparatively New Organization Is Rapidly Becoming One of the Strongest Utilities of the South

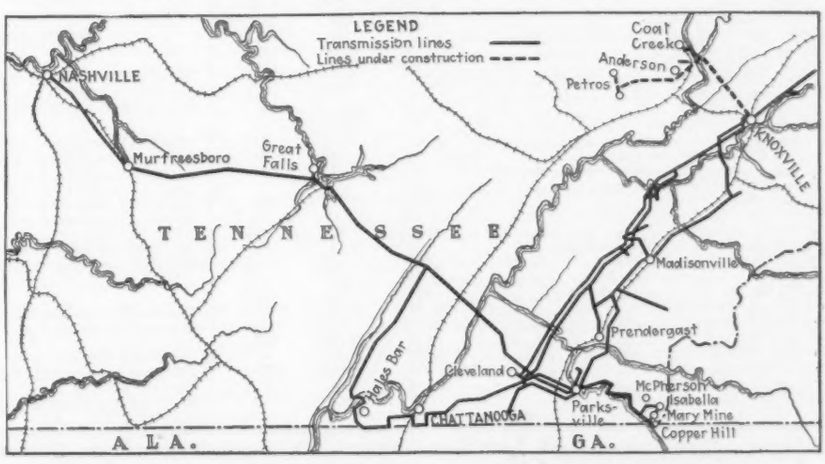
By Paul Willard Garrett

HENRY FORD'S withdrawal of his bid for Muscle Shoals calls attention afresh to the Tennessee Electric Power Company, which is one of the utilities that jointly with others had submitted a bid for the lease of the Muscle Shoals hydro-electric plant. Whatever finally is done with the plant, the power doubtless will be available for a greater development of the South, benefiting and not harming such companies as the Tennessee Electric.

The Tennessee Electric Power Company was incorporated less than three years ago, early in 1922, but represents the consolidation of various companies that have for years been important factors in developing the state. Since then it has shown substantial progress, and it is planning extensive developments for the future. Tennessee Electric is one of the companies that are in a strategic position to grow but whose management nevertheless carries on an active and successful campaign for new business.

Situated to Get Big Business

That the Tennessee Electric Power Company serves one of the growing sections of the South is a point for utility investors to consider. The territory covers virtually the entire central and eastern portions of Tennessee,



Transmission System of the Tennessee Electric Power Company

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par value of stocks is $100.)

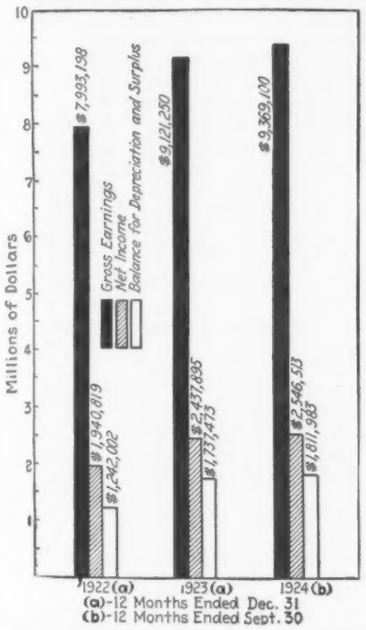
Companies	Bid Price Saturday, Nov. 15	Low 1924	High 1924
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	*a* 97½	94	97½
Appalachian Power, 7 per cent	*a* 89	85½	90
Arkansas Light & Power 7 per cent	*a* 92	81	93
Asheville Power & Light 7 per cent	95	95	99
Central Illinois Public Service 6 per cent	84	84	87
Colorado Power 7 per cent	*a* 92	90	98
Connecticut Light & Power 7 per cent	*a*105	99	106
Consumers' Power 6 per cent	*a* 90	85	93
Dayton Power & Light 6 per cent	84	84	90
Duquesne Light 7 per cent	105	103½	107½
Eastern Texas Electric 6 per cent	*a*100	81	100
Empire District Electric 6 per cent	73	70	78
Fort Worth Power & Light 7 per cent	99	97	102
Great Western Power 7 per cent	97	96	99
Illinois Northern Utilities 6 per cent	85	84	87
Illinois Power & Light 7 per cent	*a* 92	84	95
Kansas Gas & Electric 7 per cent	94	92	97
Long Island Lighting 7 per cent	99	95½	102
Minnesota Power & Light 6 per cent	89	78	89
Mississippi River Power 6 per cent	*a* 88	80	90
Nebraska Power 7 per cent	96	89	99
Niagara Falls Power 7 per cent—25	27½	26	29
Niagara, Lockport & Ont. Power 7 per cent	101½	99½	104½
Northern States Power 7 per cent	*a* 95	91	97
Ohio Public Service 7 per cent	93	86	100
Pacific Gas & Electric 6 per cent	90	85½	92½
Penn-Ohio Power & Light 7 per cent	90	84	96½
Pennsylvania Power & Light $7—no par	98½	93	99
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	*a* 38½	29½	39½
Southern California Edison 8 per cent	*a*115	112	120
Tennessee Electric Power, 6 per cent	*a* 78½	71	81
Texas Power & Light 7 per cent	97	95	97½
Utah Power & Light 7 per cent	95½	94	96½
Western States Gas & Electric 7 per cent	80	78	85
Yadkin River Power, 7 per cent	97	94	97½
Holding Companies			
American Gas & Electric 6 per cent—50	*a* 46	41½	46
American Light & Traction	*a* 93	91	94½
American Power & Light 6 per cent	*a* 89½	84	91
American Public Service 7 per cent	88	84	92
American Public Utilities 7 per cent	*a* 88	73	90
American Water Works & Electric 6 per cent	97	89½	99
Associated Gas & Electric	48	48	50
Carolina Power & Light	99	82½	100
Central Indiana Power 7 per cent	88	80	92
Cities Service 6 per cent	81	67	83
Commonwealth Power 6 per cent	*a* 80½	72	82
Consolidated Gas 6 per cent—50	*a* 57½	51	59½
Continental Gas & Electric 7 per cent	*a* 90	69	93
Electric Bond & Share 6 per cent	*a*102	96½	103
General Gas & Electric—$8—no par	*a*103½	96	103½
*Middle West Utilities 7 per cent	*a* 91½	80	91½
National Power & Light—$7—no par	*a* 93½	84	96½
North American 6 per cent—50	*a* 47½	43½	50½
Northern Ohio Electric	*a* 29	16	34
Public Service Corp. of N. J. 7 per cent	100	96½	100½
Public Service Corp. of N. J. 8 per cent	*a*109	99½	110
Standard Gas & Electric 8 per cent—50	*a* 49½	46½	49½
‡United Gas Improvement—50	58	55½	58
United Light & Power—$6.50—no par	83½	75½	84
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	*a* 30	22½	34
Appalachian Power—no par	*a* 71	66	93
Arkansas Light & Power	*a* 60	22	63
Brooklyn Edison	*a*119½	107½	120½
Buffalo General Electric	151	118	155
Colorado Power	*a* 33	21	35
*Commonwealth Edison	*a*132½	126	135
§Consolidated Gas, Electric Light & Power	*a* 33½	33	37½
Dayton Power & Light	153	70	160
Detroit Edison	*a*110½	102½	110½
|| Edison Electric Illuminating of Boston	*a*183	163½	190
*Kentucky Hydro-Electric	87½	84	87½
Long Island Lighting	160	100	195
Mississippi River Power	*a* 33	18½	34
Montana Power	*a* 67	61½	71
Niagara Falls Power—no par	42	42	48
Niagara, Lockport & Ontario Power—no par	51	45	59
Northern Ohio Electric—no par	*a* 10	5	16
Northern States Power	*a*101	92	106
North Texas Electric	*a* 60	58	84
Pacific Gas & Electric	*a* 99½	90½	99½
‡Penn Central Light & Power—no par	59½	57	60
§Pennsylvania Water & Power	133	98½	135½
‡Philadelphia Electric—25	*a* 38½	29	39½
*Public Service Co. of Northern Illinois	102½	96	103½
Puget Sound Power & Light	*a* 51	43½	61½
Southern California Edison	*a*100½	95	106
Tampa Electric	*a*168	134	167
Tennessee Electric Power—no par	*a* 40	20	43
Virginia Power	50	16	70
Virginia Railway & Power	*a* 64	36	72½
West Penn. Co.	83	47½	98

Companies	Bid Price Saturday, Nov. 15	Low 1924	High 1924
Holding Companies			
‡American Electric Power—50	62	22½	62½
American Gas & Electric—no par	*a*104	43½	104
American Light & Traction	*a*135½	115	148
American Power & Light (new)	*a* 47½	34½	48½
American Public Utilities	*a* 75	35	97
American Water Works & Electric	*a*118	40	126½
Carolina Power & Light—no par	225	103	240
Cities Service	*a*168	140	174
Columbia Gas & Electric—no par	*a* 46½	33	46½
Commonwealth Power Corp.—no par	*a*100	56	109
Consolidated Gas—no par	*a* 76½	60½	76½
Continental Gas & Electric	*a* 82	49	96
Federal Light and Traction	*a*101	75	102
General Gas & Electric	*a* 55	22	63
Lehigh Power Securities—no par	*a* 85½	31	89
*Middle West Utilities—no par	*a* 77	41	86
National Power & Light—no par	*a*157	60	190
North American—10	*a* 38	22	38
Philadelphia Co.—50	*a* 50½	42½	53½
Power Securities—no par	*a* 12	4	14
Public Service Corp. of N. J.—no par	*a* 62½	39	63
Standard Gas & Electric—no par	*a* 39½	31½	40½
United Gas & Electric (Conn.)—no par	29	14	42
Utah Securities	*a* 36	16½	37
BONDS			
Operating Companies			
Adirondack Power & Light	6s 1950	*a*102	97½ 103
Alabama Power	5s 1946	96½	90½ 97
Appalachian Power	5s 1941	*a* 96	89 96
Brooklyn Edison	5s 1949	*a*101½	97½ 102½
	6s 1930	*a*103½	102½ 106½
	7s 1940	*a*107½	107 110½
Cleveland Electric Illuminating	5s 1939	101	98½ 101
Commonwealth Edison	5s 1943	99½	95 100
	5s 1953	98½	92 99½
§Consol. Gas, Elec. Lt. & Pwr.	4½s 1935	*a* 92½	91½ 95
	6s 1949	106	102½ 106
Consumers' Power	5s 1936	98½	94½ 99½
	5s 1952	*a* 91½	87 92½
Detroit Edison	5s 1933	*a*101	99 101½
Duquesne Light	6s 1949	*a*105½	103½ 106½
Great Western Power	5s 1946	95	90½ 96
Kansas City Power & Light	5s 1952	*a* 94½	89 96
Mississippi River Power	5s 1951	*a* 97½	92 97½
Montana Power	5s 1943	*a* 98½	95 99
New England Power	5s 1951	100½	97 101
New York Edison	6½s 1941	*a*114½	109½ 114½
Niagara Falls Power	6s 1950	105½	104 105½
Northern States Power	5s 1941	*a* 94½	89½ 94½
	6s 1941	*a*104½	101 104½
Ohio Power	7s 1951	106½	103 106½
Pacific Gas & Electric	5s 1942	*a* 94½	90½ 95
Pennsylvania Water & Power	5s 1940	99½	96 99½
‡Philadelphia Electric	5s 1966	*a*101	97 103½
	5½s 1947	105	99½ 105
	6s 1941	*a*107	103½ 107½
Portland Electric Power	6s 1947	94½	89½ 97
Southern California Edison	5s 1939	99½	96 100
	6s 1944	103½	100 103½
Tennessee Electric Power	6s 1947	*a* 98½	93½ 98½
Texas Power & Light	5s 1937	97	91½ 97
Toledo Edison	7s 1941	*a*109½	106 110
Utah Power & Light	6s 1944	*a* 92½	87½ 93½
Holding Companies			
Alabama Traction, Light & Power	5s 1962	84½	65½ 86
American Gas & Electric	6s 2014	*a* 95	94 95½
American Power & Light	6s 2016	*a* 93½	91 94½
Amer. Water Works & Electric	5s 1934	*a* 92½	84½ 94
Associated Gas & Electric	6½s 1954	*a* 92½	92½ 97½
Central Indiana Power	6s 1947	95½	88 96
Commonwealth Power	6s 1947	*a* 97½	87 98
Consolidated Cities Lt., Pwr. & Tr.	5s 1962	75½	64 76½
Illinois Power & Light	6s 1953	99½	95 100½
United Light & Railways	5s 1932	94½	87½ 94½
	6s 1952	96	92 97½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing		100½	90 101½
*National Carbon		118½	112 125
Worthington Pump & Machinery—A		*a* 87	68 87
COMMON STOCKS			
Allis-Chalmers Manufacturing		*a* 63	41½ 66½
American Bosch Magneto—no par		*a* 27½	22½ 38½
Electric Storage Battery—no par		*a* 62½	50½ 64
General Electric		*a*278	193½ 281
General Electric—10		*a* 11½	10½ 11½
*Hurley Machine—no par		*a* 64½	48 65½
†Wagner Electric		25½	20 34½
Westinghouse Electric & Manufacturing—50		*a* 65½	55½ 65½
Worthington Pump & Machinery		*a* 49½	23½ 50½
BONDS			
Canada General Electric	6s 1942	106½	102½ 107
General Electric	3½s 1942	84	80 84
	5s 1952	*a*105½	100 105½
Robbins & Myers	7s 1952	66	66 91½
†Wagner Electric Manufacturing	7s	100	97 101
Western Electric	5s 1944	*a* 99	96 99½
Westinghouse Electric & Mfg.	7s 1931	*a*108½	106½ 109½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange. § Baltimore Stock Exchange.
a Bid price Wednesday, November 19.

including such centers as Nashville and Chattanooga. Power is also supplied to Knoxville on a wholesale basis. Industry in that region has had and still is having a growth so great as fairly to seem romantic.

To handle the increasing volume of business the Tennessee Electric Power Company has turned funds on a large scale into the construction of new plants and transmission lines. Most of the energy heretofore has been generated by hydro-electric stations and at seasons when the Tennessee River is low the company has not been able to supply enough power to satisfy the demand. The new steam plant at Hales Bar will hold the capacity up at all seasons of the year. Other interesting developments include the construction of a 120,000-volt transmission line from



ANNUAL EARNINGS OF THE TENNESSEE ELECTRIC POWER COMPANY SHOW CONTINUOUS GAIN

Cleveland to Knoxville, a distance of 80 miles; the extension of a line from Knoxville to the coal-mining section, and a new 120,000-volt transmission line from Ridgedale to the Georgia State line, where connection is made with the Georgia Railway & Power Company.

CAPITAL STRUCTURE PERMITS GROWTH

That the Tennessee Electric Power Company will be able to grow as its territory grows is assured in part by the possession of a capital structure that will enable the company to do financing far into the future. The working mortgage, representing the first and refunding bonds, is an open rather than a closed lien. The company's total funded debt of $36,593,900 is divided as follows: $22,135,400 in first and refunding mortgage 6s of 1947, $12,508,500 in divisional lien bonds and $1,950,000 in 6½ per cent debenture obligations.

Following the bonds come three types of first preferred stock, of which the most important is the 7 per cent issue. The first preferred stock has a par value of $100. The second preferred, which received its initial payment this year and now is on a $6 per share dividend basis, is outstanding to the amount of 50,000 shares of no par value. The common stock, which has not yet been placed on a dividend basis, is outstanding to the amount of 156,000 shares. Since December 31, 1923, when the movement was started, the company has sold preferred stock under the customer-ownership plan to the amount of more than a million dollars.

EARNINGS ON THE GAIN

The electric light and power business of the Tennessee Electric Power system has more than trebled in the last decade, a significant thing in view of the fact that more than 82 per cent of the company's aggregate net earnings are derived from the electrical department. Both gross and net earnings have improved substantially since the present company was formed in 1922. The Tennessee Electric Power Company was able to continue its improvement during the summer months this year when general business throughout the country was at its lowest ebb. With a gross business now totaling between $9,000,000 and $10,000,000 a year, the company is earning comfortable margins on all of its investment issues.

Columbus (Ga.) Company Plans Bond and Stock Issues

The rapid growth of business on the system of the Columbus (Ga.) Electric & Power Company has led the directors to call a stockholders' meeting at Columbus December 1 for the following purposes:

1. To see if the stockholders will ratify the action of the directors in authorizing the issue, under the company's first and refunding mortgage dated June 1, 1922, of an additional series of first and refunding mortgage gold bonds, dated November 1, 1924, and due November 1, 1954, the same to be of series B and to bear interest at a rate not exceeding 5½ per cent per annum, the initial issue thereof being $2,000,000.

2. To see if the stockholders will authorize and consent to the bonding of the company's property, rights, privileges and franchises, both present and future acquired, to an aggregate principal amount not exceeding $8,500,000, including the $1,470,800 series A bonds already issued and now outstanding under said mortgage and the $2,000,000 of series B bonds above mentioned, and to this end authorize and empower the directors from time to time in their discretion to issue, under said mortgage and in conformity with the provisions thereof, bonds in such installments and series as they may deem advisable, but within the limitation as to aggregate principal amount herein specified.

3. To see if the stockholders will ratify the action of the directors in authorizing an issue of $2,000,000 three-year 5 per cent gold coupon notes of this company, dated December 1, 1924, and due December 1, 1927.

4. To see if the stockholders will authorize an increase in the capital stock of the company from $4,928,700, the amount now authorized and outstanding, to $5,428,700, the $500,000 of increased stock to be designated as series B first preferred stock, entitled to cumulative dividends at the rate of 7 per cent per annum and to be redeemable at the option of the company at $110 per share.

Company Reports

Among the company reports issued during the past week for the month of October are the following:

Name of Company	Gross Revenues for October 1924	1923
Adirondack Power & Light....	$642,147	$618,227
Appalachian Power.....	338,572	307,811
Detroit Edison.....	2,719,149	2,642,795
Manila Electric.....	318,195	309,303
Southwestern Pwr. & Lt.*.....	1,038,688	988,709
Utah Securities.....	927,498	916,890

* September.

Dividends Declared

The following quarterly dividends were announced by central-station companies and electrical manufacturing companies during the past week:

Name of Company	Per Cent	When Payable
American Power & Light, com.....	25c.	Dec. 1
American Power & Light, com*....	.....	Dec. 1
Central Indiana Power, pf.....	1¾	Dec. 1
Laclede Gas Light, com.....	$2	Dec.
Laclede Gas Light, com. (extra)....	$1	Dec.
Middle West Utilities, prior lien....	$1.75	Dec. 15
National Power & Light, com.....	$1.50	Dec. 1
National Power & Light, pf.....	$1.75	Jan. 2
Nebraska Power, pf.....	1¾	Dec. 1
Philadelphia Electric, com.....	50c.	Dec. 15
Philadelphia Electric, pf.....	50c.	Dec. 15
Southwestern Power & Light, pf....	1¾	Dec. 1
Vesta Battery, pf.....	1¾	Dec. 1

*One-fiftieth of a share of common stock.

Detroit Edison to Call Bonds.—The Detroit Edison Company will redeem its entire issue of ten-year 8 per cent convertible gold debenture bonds, series of 1931, on January 10, 1925, at 103 and accrued interest to that date.

Birmingham Electric Issues Stock.—The Birmingham (Ala.) Electric Company is offering to the people of Birmingham 20,000 shares of preferred stock of no par value. The shares, which sell for $97, may be bought on the installment plan, $10 per share down and $10 per month.

Olean (N. Y.) Utility to Expand.—The Olean Electric Light & Power Company is seeking authority from the Public Service Commission of the State of New York to acquire the capital stock of the Cuba (N. Y.) Electric Company held by Robert E. Bartlett of Cuba. The Cuba utility has been purchasing its energy from the company at Olean.

Kentucky Utilities' Property Bought.—The International Utilities Corporation, New York, has acquired control of the Kentucky Securities Corporation, which controls the public utilities of Lexington, Ky. These subsidiaries are the Kentucky Traction & Terminal Company, the Lexington Ice Company and the Lexington Utilities Company.

Calumet Gas & Electric Inaugurates Customer-Ownership Campaign.—Customers of the Calumet Gas & Electric Company, which serves sixty-two com-

munities in northern Indiana with electricity or gas, are to have the opportunity of becoming partners in the business through the customer-ownership plan. In inaugurating a customer-ownership campaign through this company Samuel Insull, president, is following the plan which has proved so successful in other public utility companies under his management. The Public Service Commission of Indiana has authorized the issuance of 7 per cent preferred stock with a par value of $1,500,000, which will be offered to investors at $95 a share. Employees of the company began to sell this stock November 1 in Elkhart, Valparaiso, Crown Point, East Gary, Plymouth, North Judson, Knox, La Grange, and other communities in which the company operates, and also in Gary, where the general offices of the company are located.

Southern Power & Light Acquires New Properties.—The Southern Power & Light Company has acquired the entire outstanding common stocks of the recently formed Louisiana Power Company and the Louisiana Power & Light Company, details concerning the organization of which appeared in the ELECTRICAL WORLD at the time of their formation.

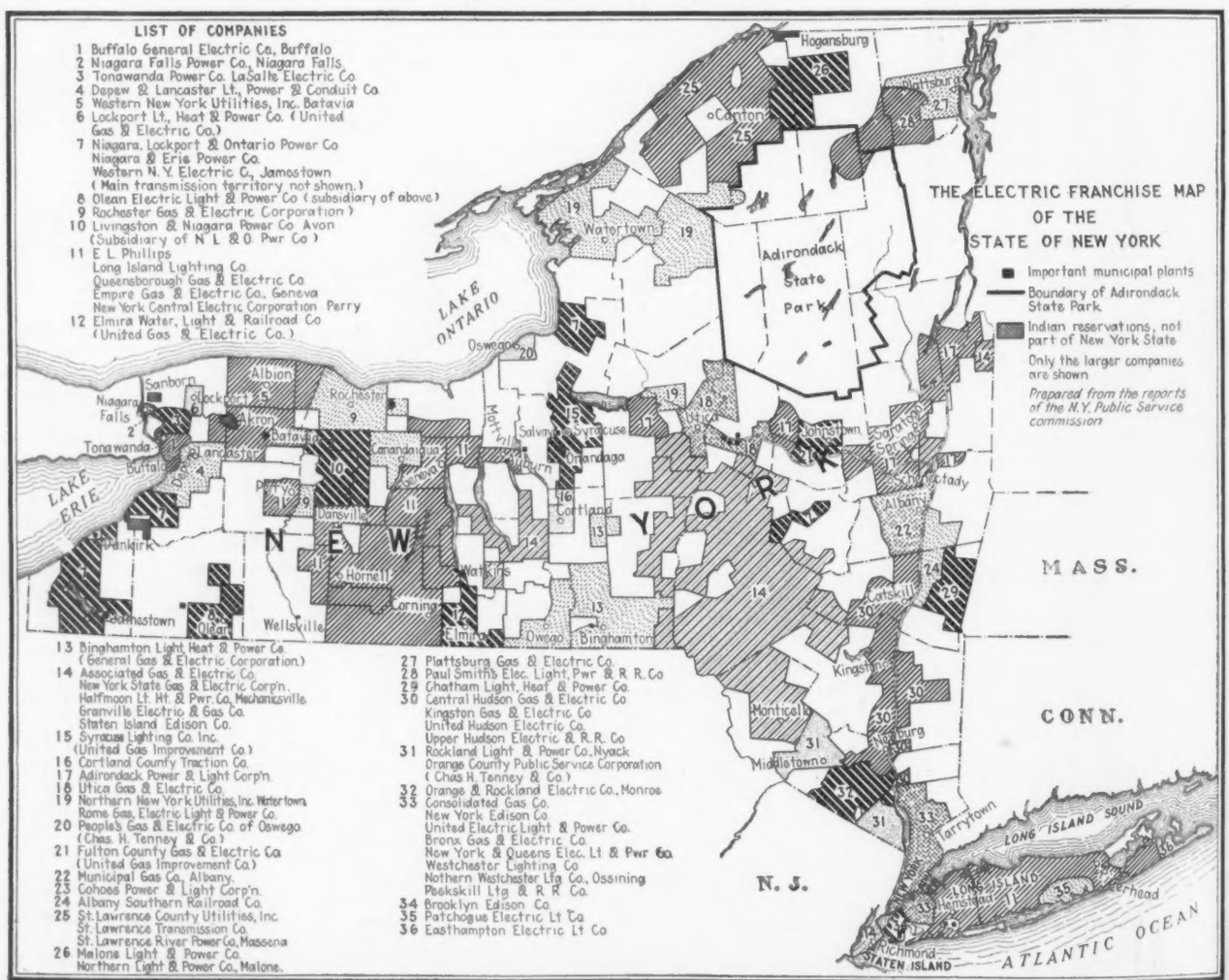
North American Company Income Statement.—The consolidated income statement of the North American Company, whose principal subsidiaries serve Cleveland, Milwaukee and St. Louis with electric light and power, for the twelve months ended September 30, 1924, shows gross earnings of $78,513,133, an increase of $7,725,193, or 10.91 per cent, for the year, and net income of $30,296,632, an increase of $4,341,949, or 16.73 per cent. Electrical output for the twelve months ended September 30, 1924, amounted to 2,258,117,867 kw.-hr., an increase of 191,540,627 kw.-hr., or 9.27 per cent. Further improvement in demands for electric service was noted in September. During the last twelve months 62,526 electric customers were added, 635,645 being the number served on September 30, 1924.

Consolidation of Electric Utilities in New York

THE tendency toward consolidation of electrical distributing companies in New York may be seen in the accompanying map, showing the franchise areas and control of approximately 90 per cent of the territory served by central-station companies. Ownership or control of the different properties is indicated on the map by numbers corresponding to those opposite the names of the various listed companies. White space in which no number appears represents a territory in which there is either no electric service because of the sparsely settled condition of the country or else it is served by some one of ninety utilities not affiliated with any parent holding company.

The consolidation of contiguous territories under one ownership is readily apparent, showing how the utilities are taking steps to effect economies in operating and financing under a centralized management. As a step toward a superpower system throughout the state these consolidations will afford distinct advantages in providing rights-of-way and in securing franchises.

Compared with conditions ten years ago, when the electric franchise area was confined almost entirely to the corporate limits of cities and towns, this map shows a marked extension of electric service into rural territories, an indication of the interest which central-station companies in general have taken in putting electric service on the farm.


LIST OF COMPANIES
1 Buffalo General Electric Co., Buffalo
2 Niagara Falls Power Co., Niagara Falls
3 Tonawanda Power Co. LaSalle Electric Co
4 Depew & Lancaster Lt., Power & Conduit Co
5 Western New York Utilities, Inc. Batavia
6 Lockport Lt., Heat & Power Co. (United Gas & Electric Co.)
7 Niagara, Lockport & Ontario Power Co
Niagara & Erie Power Co.
Western N. Y. Electric Co., Jamestown
(Main transmission territory not shown.)
8 Olean Electric Light & Power Co (subsidiary of above)
9 Rochester Gas & Electric Corporation)
10 Livingston & Niagara Power Co. Avon
(Subsidiary of N. L. & O. Pwr Co)
11 E. L. Phillips
Long Island Lighting Co.
Queensborough Gas & Electric Co.
Empire Gas & Electric Co., Geneva
New York Central Electric Corporation Perry
12 Elmira Water, Light & Railroad Co
(United Gas & Electric Co.)
13 Binghamton Light, Heat & Power Co.
(General Gas & Electric Corporation.)
14 Associated Gas & Electric Co.
New York State Gas & Electric Corp'n.
Halfmoon Lt. Ht. & Pwr. Co, Mechanicsville
Granville Electric & Gas Co.
Staten Island Edison Co.
15 Syracuse Lighting Co. Inc.
(United Gas Improvement Co.)
16 Cortland County Traction Co.
17 Adirondack Power & Light Corp'n.
18 Utica Gas & Electric Co.
19 Northern New York Utilities, Inc. Watertown
Rome Gas, Electric Light & Power Co.
20 People's Gas & Electric Co. of Oswego
(Chas. H. Tenney & Co.)
21 Fulton County Gas & Electric Co
(United Gas Improvement Co.)
22 Municipal Gas Co., Albany.
23 Cohoes Power & Light Corp'n.
24 Albany Southern Railroad Co.
25 St. Lawrence County Utilities, Inc.
St. Lawrence Transmission Co.
St. Lawrence River Power Co, Massena
26 Malone Light & Power Co.
Northern Light & Power Co., Malone.
27 Plattsburg Gas & Electric Co.
28 Paul Smiths Elec. Light, Pwr & R. R. Co
29 Chatham Light, Heat & Power Co.
30 Central Hudson Gas & Electric Co
Kingston Gas & Electric Co
United Hudson Electric Co.
Upper Hudson Electric & R. R. Co
31 Rockland Light & Power Co., Nyack
Orange County Public Service Corporation
(Chas. H. Tenney & Co.)
32 Orange & Rockland Electric Co., Monroe
33 Consolidated Gas Co.
New York Edison Co.
United Electric Light & Power Co.
Bronx Gas & Electric Co.
New York & Queens Elec. Lt & Pwr Co.
Westchester Lighting Co
Nothern Westchester Ltg Co., Ossining
Peekskill Ltg & R. R. Co.
34 Brooklyn Edison Co.
35 Patchogue Electric Lt Co
36 Easthampton Electric Lt Co
THE ELECTRIC FRANCHISE MAP OF THE STATE OF NEW YORK
Important municipal plants
Boundary of Adirondack State Park
Indian reservations, not part of New York State
Only the larger companies are shown
Prepared from the reports of the N.Y. Public Service commission
LAKE ONTARIO
LAKE ERIE
Adirondack State Park
Hogansburg
Canton
Watertown
Oswego
Sanborn
Niagara Falls
Tonawanda
Buffalo
Lancaster
Albion
Stockport
Akron
Batavia
Rochester
Dansville
Hornell
Corning
Elmira
Olean
Jamestown
Wellsville
Salvania
Syracuse
Onondaga
Cortland
Binghamton
Owego
Watkins
Johnstown
Saratoga Springs
Albany
Catskill
Kingston
Montiello
Middletown
Tarrytown
Hempstead
Riverhead
Richmond
STATEN ISLAND
LONG ISLAND SOUND
LONG ISLAND
ATLANTIC OCEAN
N. J.
MASS.
CONN.
N E W Y O R K
Electrical World

MAP SHOWS OWNERSHIP OR CONTROL OF ELECTRIC UTILITIES IN 90 PER CENT OF NEW YORK TERRITORY SERVED BY CENTRAL STATIONS